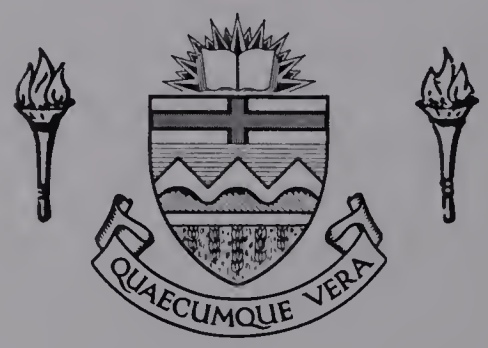

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APTITUDES FOR ACHIEVEMENT IN THE VOCATIONAL PROGRAMS OF ONE COMPOSITE HIGH SCHOOL IN ALBERTA

by

JOHN THEODORE KARPOFF

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES

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DEPARTMENT OF EDUCATIONAL ADMINISTRATION

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UNIVERSITY OF ALBERTA

FACULTY OF GRADUATE STUDIES

The undersigned hereby certify that they have read and recommend to the Faculty of Graduate Studies for acceptance, a thesis entitled, "Aptitudes for Achievement in the Vocational Programs of One Composite High School in Alberta," submitted by John Theodore Karpoff, in partial fulfillment of the requirements for the degree of Master of Education.

Date September 22, 1967

ABSTRACT

The concern of this study was to identify student aptitudes that are associated with successful achievements in vocational education programs. The specific purpose of the statistical treatment was to determine whether there existed significant relationships between certain measures of student aptitude and achievement in the Vocational 22 courses of one Alberta Composite High School.

The sample, totaling some 646 subjects, consisted of the students who completed the Vocational 22 courses in June 1964, 1965, or 1966 and for whom complete aptitude data were available. The criterion of achievement was the final mark received in the vocational courses: Automotives 22, Beauty Culture 22, Commercial Art 22, Commercial Foods 22, Drafting 22, Electricity 22, Electronics 22, Graphic Arts 22, Machine Shop 22, and Performing Arts 22. The predictor variables were the twenty-seven scores obtained from: (1) the Alberta Grade IX Record, (2) the Differential Aptitude Test Battery, and (3) the Kuder Preference Record-Vocational.

A "Step-wise Multiple Regression Analysis Program" was used to establish the existence of significant predictive relationships and to arrange, within "sets" of Multiple regression equations, the weighted predictors in descending order, from the most efficient to the least, to account for criterion variance. The results of the statistical analysis indicated:

1. The predictor variables, with the exceptions of Kuder Mechanical and Kuder Musical, were found to have a significant

relationship to achievement in at least one or more of the Vocational 22 courses. A relatively high incidence of negative correlation was observed to be associated with the Kuder-Vocational.

2. The combination of the aptitude variables within multiple regression equations resulted in an increase in the correlation coefficients over those obtained with any of the single predictors of achievement. When used in weighted combination, between four and seven of the predictor variables accounted for the maximum possible criterion variance, which ranged from 29.19 per cent to 69.07 per cent.

3. The most useful predictors of Vocational 22 course achievement, in descending value, were: Science IX, Space Relations, Aggregate Stanine, Clerical Speed and Accuracy, and Literature IX. However, at least one variable from each of the three predictive batteries occurred in each of the optimum regression equations.

On the basis of this investigation it was concluded that the selected measures of student aptitude have potential value as predictive instruments for vocational programs. The observed differentiation in the relative contribution of the variables to the prediction equations associated with each Vocational 22 course suggests future development of probability profiles and discriminant scores. The findings indicate a need to re-examine the practice of using only the Grade IX Record as allocation criteria; and further, the use of the interpretation provided on the Kuder-Vocational "Profile Sheet" requires further clarification if it is to be used as a guidance device for the vocational programs.

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CHAPTER I

INTRODUCTION TO THE PROBLEM

In any complex society the educative activity of the public school must satisfy a wide range of social and individual needs. Therefore, the school must establish alternative instructional programs to provide different kinds and amounts of education. Whenever this occurs, some process of student allocation is necessary to distribute the student personnel into these alternative instructional situations.

Student allocation involves three related functions: selection, placement, and advancement of student personnel. The allocation process has the effect of structuring and controlling an individual's potential educational experience. "Effective allocation" maximizes the occurrence of student achievement which accomplishes the objectives of the particular instructional program.

A variety of allocation criteria has been utilized, formally and informally and in varying combinations, by educational institutions. Academic and vocational achievement, intelligence test performance, aptitude test performance, declared or measured interest and attitude, amount of time in a program or subject, age, sex, race, religion, socio-economic status, and geographic location are but a few examples of the criteria noted in educational literature.

Brim concludes that at the elementary school level, initial selection is based almost wholly on chronological age, and advancement has

traditionally been by age-grade performance. At higher educational levels, personal characteristics and performance criteria gain importance as a basis of selection, placement, and advancement.[1]

It may be assumed that effective student allocation is dependent on the determination of which characteristics of aptitude are more relevant to future success, and which are less relevant in a particular instructional program. Educational research frequently reflects the continuing interest in the discovery of promising predictors of student achievement and in the behavioural prerequisites desirable for entry into the various instructional programs and courses.[2] The continuing premise is that, in a particular instructional program of the school, there are quantitatively definable "relationships" between certain measurable aspects of "student aptitude" and measurable aspects of "student achievement."

In terms of developing effective allocation criteria for the Alberta High School System, a major shortcoming of previously available research has been that it seldom takes into account the newer vocational education programs or courses introduced into selected schools since 1963. A review of available educational literature and reference indexes revealed only one study, that by Campbell, which used as the criterion

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[1]Orville G. Brim, Jr., Sociology and the Field of Education (New York: Russell Sage Foundation, 1958), p. 41.

[2]For one indication of the continuing interest of educational research in predictors of achievement note the frequency of prediction studies listed within the bibliographies that are associated with each of the testing instruments reviewed in: Oscar K. Buros (ed.), The Sixth Mental Measurements Yearbook (New Jersey: The Gryphon Press, 1965); also see the review of related literature in Chapter III of this study, infra, pp. 35-68.

variable, achievement in any of the Vocational Education 12, 22, or 32 courses offered in Alberta.[3]

Although the inclusion of the vocational programs increases the educational alternatives available, research has not adequately determined whether the addition has increased the probability of high school success to students of a greater range of interests and abilities. For example, can research show that the student aptitudes required for effective performance in vocational programs or courses are significantly different from those required for academic programs or courses? Do certain dimensions of student aptitude contribute differently toward prediction of success in alternative vocational courses?

The conclusion is, that while research and theoretical discussion have suggested many guide lines regarding aptitude profiles for vocational programs, there has been a failure to quantitatively describe these with sufficient validity in the context of the Alberta High School, to be of much practical use in the allocation of students. Conversely, the practice of using established predictors of academic course achievement as allocation criteria for the relatively nonacademic vocational courses, without first determining their predictive validity in this new context, is unwarranted.

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[3]T. R. Campbell, "Grade Nine Marks as Predictor Criteria for Success in Selected Vocational Subjects" (unpublished Master's thesis, The University of Alberta, Edmonton, 1966).

I. THE PURPOSE OF THE STUDY

The general concern of the study was to identify and describe those student aptitudes that are associated with successful achievements in the vocational programs of the Alberta High School System. The specific purpose of this research investigation was to establish the validity of estimating Vocational 22 course achievements from certain measures of "student aptitude."[4]

The assumed measures of student aptitude were the scores obtained from the Alberta Grade IX Record,[5] the Differential Aptitude Test Battery,[6] and the Kuder Preference Record-Vocational.[7] These measures were favored as indicators of student potential by administrative tradition in the Composite High School under consideration. They were considered as providing valuable student guidance information and were utilized, in varying degrees, as allocation criteria for determining initial membership in the alternative instructional programs.

An intended contribution of this study was to generate for each Vocational 22 course a multiple regression equation, utilizing those

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[4] Student aptitude as defined in this study, infra pp. 35-38.

[5] The Grade IX Record refers to the scores derived from the sets of examinations externally developed, scored, and standardized by the Department of Education of the Province of Alberta, which are administered to all Grade IX students at the end of June of each year.

[6] Differential Aptitude Tests Form L, Booklet 1 and 2 (New York: The Psychological Corporation, 1962).

[7] Kuder Preference Record, Vocational Form CH (Chicago: Science Research Associates, 1948).

measures of student aptitude having a validated relationship to achievement. These predictive devices would be functionally useful in developing more effective allocation procedures for the alternative vocational programs offered.

II. THE ASSUMED ANALYTICAL PERSPECTIVE[8]

The basic construct, underlying this investigation, may be stated as: the amount learned in any instructional program is a function of the student's aptitude. The predictor and criterion measures which were specifically considered in this study, together with the hypothesized functional relationships, are illustrated in Figure 1.

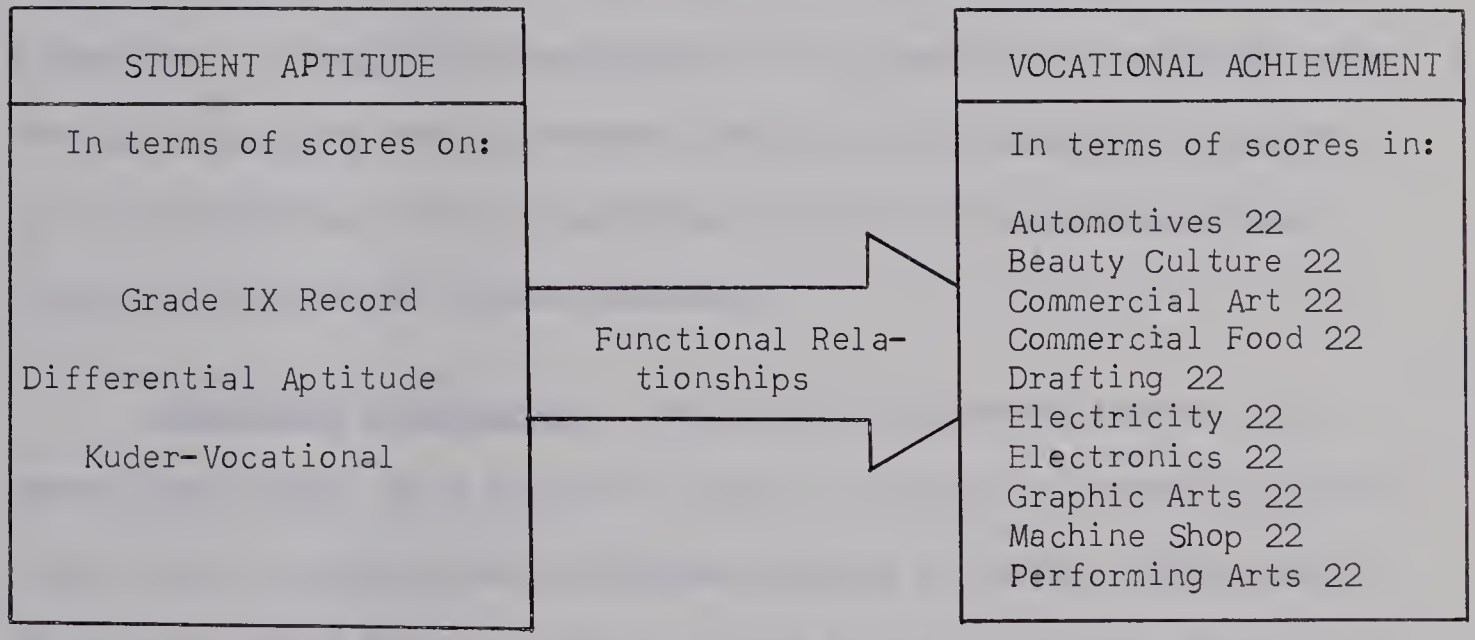

Figure 1. The predictor and criterion measures showing the relationships hypothesized in this investigation.

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[8] Because of the number of references used to define the basic concepts of this study, no effort will be made here to credit points derived from others. Further consideration and documentation supporting these basic assumptions will be provided in later sections of this report.

The Research Hypothesis

The specific hypothesis tested was: Achievement in the Vocational 22 courses is functionally related to dimensions of student aptitude as measured by: (1) the Alberta Grade IX Record, (2) the Differential Aptitude Test Battery, and (3) the Kuder Preference Record-Vocational.

Definition of Terms

The vocational programs. The vocational programs are special purpose "instructional programs," within the context of the Alberta High School System, which contain a Vocational Education 12, 22, and 32 course sequence of not less than thirty-five high school credits. Vocational Education courses are intended to provide the basic preparation and, as far as is possible, the specialized behaviour necessary for entry, advancement, or additional education in one specific occupational area. The distinguishing feature between the different vocational programs is the variations in the occupational content of the relevant Vocational 12, 22, and 32 course sequences.

Vocational achievement. Vocational achievement refers, in a generalized sense, to a student's level of success in accomplishing the objectives of a particular vocational program or course. More specifically, the term "vocational achievement" may be defined as the level of correspondence between a student's observed behaviour and some conceptualized model of ideal behaviour. The reference model generally associated with evaluations of vocational achievement is the behaviour of typically competent persons in relevant occupational areas. For the

purpose of this investigation, the level of a student's vocational achievement will be quantitatively described by the final course marks awarded in Automotives 22, Beauty Culture 22, Commercial Art 22, Commercial Foods 22, Drafting 22, Electricity 22, Electronics 22, Graphic Arts 22, Machine Shop 22, and Performing Arts 22.

Student aptitude. Student aptitude refers to the individual's potential for learning and for successful achievement within an instructional program. Specifically, student aptitude may be defined as the "conditioned set of characteristics" regarded as indicative of an individual's ability to acquire some particular knowledge, skill, or set of responses. In this study, the term "aptitude" embraces any characteristic, including intelligence, achievement, personality, interests, and special skills, which predisposes to learning. For the purpose of this investigation student aptitude will be quantitatively described by the twenty-seven scores obtained by: the Alberta Grade IX Record, the Differential Aptitude Test Battery (Form L), and the Kuder Preference Record-Vocational (Form CH).

Delimitations of the Study

This investigation is delimited in its statistical treatment to one aspect of the total vocational program, that is, the student's achievement in the Vocational 22 course as it relates to the specified measures of aptitude. Delimitation was imposed by the sample selected which included only those students with complete aptitude data and who received a final mark in a Vocational 22 course in June, 1964, 1965, or

1966 at one Composite High School. Delimitation also results from the necessity of having to use nonstandardized and highly subjective evaluation procedures to determine the level of vocational achievement.

These restrictions impose limitations on any generalizations which might be drawn from the findings. Any transfer of conclusions from this investigation to the context of other instructional situations or to similar vocational courses in other schools must be made with extreme caution.

CHAPTER II

ACHIEVEMENT DIMENSIONS OF THE VOCATIONAL PROGRAMS

The criterion variable in this investigation is "student achievement," in vocational education programs of the Alberta High School System. It logically follows that this study must comprehend the general nature of the achievement dimensions that are associated with the vocational programs under investigation.

Specifically, the purposes of this section were to derive and describe the achievement dimensions typically associated with the Vocational programs and courses by:

1. Examining, briefly, dimensions of achievement normally associated with instructional programs of the public school.
2. Examining, in the light of "The Contemporary Tasks of the Alberta High Schools," the rationale for the creation of vocational programs.
3. Examining the structure and context associated with the alternative vocational programs and courses.

This orientation was assumed necessary to properly define the research hypothesis and to guide the review of related research to pertinent situational contexts.

I. THE ACHIEVEMENT DIMENSIONS OF INSTRUCTIONAL PROGRAMS

An instructional program, when conceived in terms of an organized

group, may be defined as an "open ended input-output interaction system."[1] "Instruction" refers to the aggregate of all the means or processes by which the school controls or manipulates student interaction to produce modifications of behaviour through learning.[2] The term "instructional program" is used in a broad context to include all the structures, operations, and environments associated with an "organized group."

Both the inputs and outputs of an instructional program are the elements of individual behaviour which may be defined in terms of the two complex referents, performance and expectation. Performance was defined as any response which identifies the individual as a participant of the interaction system.[3] Expectation was defined as the "readiness for reinforcement."[4] The intended process of the instructional program is the educative process and the intended outcome, the modification of the individual's behaviour.

It is assumed that both instructional tasks and student achievement can be considered as behaviour or products of behaviour. When the group task is specified as products of behaviour, then productivity is evaluated in terms of material goods. When the group task is specified as behaviour required, then productivity is evaluated in terms of individual performance and expectation. In both cases productivity measurement requires a

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[1]Ralph M. Stogdill, Individual Behaviour and Group Achievement (New York: Oxford University Press, 1958).

[2]A. A. Lumsdaine, "Instruments and Media of Instruction," Handbook of Research on Teaching (Chicago: Rand McNally and Company, 1963), p. 584.

[3]Stogdill, op. cit., pp. 40-42. [4]Ibid., pp. 59-75.

valid reference base so that "change" in behaviour, physical resources, or both is measurable.

It must be emphasized that any "evaluation" of actual functions of the instructional programs of the school are strongly influenced by the ultimate criteria used. Smith, et al., review the criterion used at different times, which may be classified in terms of social adequacy, individual needs, behaviouristic change, democratic ideals, or content learned.[5]

A significant assumption of this investigation is that the productivity of the educative organizations of the school are in terms of the transformation of the student input behaviours into those qualities of individual behaviour that are institutionally desired. To the extent that the school's operations are the teaching-learning process, the product of the school is behavioural change.

The achievement of students may be analyzed in terms of the relative contribution to instructional purpose or to individual need. Benne and Sheats note three possible levels of operational behaviour which: (1) facilitates the accomplishment of group task; (2) serves in building and maintaining the group; and (3) satisfies the needs of the individual without regard to group purpose.[6] Other investigators, such as Brim, describe operational performance in more general terms of actual "role

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[5] O. B. Smith, W. O. Stanley, and J. H. Shores, Fundamentals of Curriculum Development (New York: World Book Company, 1957), pp. 107-23 and 586-603.

[6] K. D. Benne and P. Sheats, "Functional Roles of Group Members," Journal of Sociological Issues, IV:2 (1948), pp. 41-49.

behaviour" or "role performance."[7]

Some of the methods of obtaining qualitative descriptions of operational performances are examined by Stogdill[8] and include such approaches as structured observations, critical incidents techniques, job analysis, and time-motion studies. The measurements of expectation, while extremely difficult because it is an inferred aspect of behaviour, are generally attempted with interest inventories, personality tests, or other psychological and sociometric instruments. The various methods and theoretical considerations of evaluating behaviour or student achievement in the school situation are thoroughly reviewed in Gage,[9] Stoughton,[10] and, with emphasis on appraising vocational fitness, by Super and Crites.[11]

An important conclusion derived from these references was that "student achievement" only has meaning when the students' behaviours are evaluated in terms of the intended outcomes of the instructional programs of the school.

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[7]Orville G. Brim, Jr., Sociology and the Field of Education (New York: American Book Company, 1955), Part II.

[8]Stogdill, op. cit., pp. 47-51.

[9]N. L. Gage (ed.), Handbook of Research on Teaching (Chicago: Rand McNally and Company).

[10]Robert W. Stoughton, "How to Test and Use Test Results More Effectively," School Executive's Guide (Englewood Cliffs, N.J.: Prentice-Hall Editorial Staff, 1964), pp. 557-86.

[11]Donald E. Super and John O. Crites, Appraising Vocational Fitness (New York: Harper and Row, 1962.

II. THE RATIONALE OF THE VOCATIONAL PROGRAMS

The premise was: A rationale for vocational education is consistent with the social purposes of the school and is inherent in the tasks of the Alberta high school. The assumption was that extra-organizational conditions generate the instructional purposes and to a large extent predetermine the nature and function of a particular instructional program.

The Contemporary Tasks of the Alberta High Schools

Two dimensions of instructional purpose are recognized by the Alberta educational system, and are noted in Program of Studies for Alberta Schools, which states: "the school must recognize and accept the inherent nature of man and second, must satisfy the fundamental demands of the social order of the day."[12]

To the extent that the selected publications of the Alberta Department of Education[13] and the conclusions of the Alberta Royal Commission on Education[14] accurately interpret, and have been interpreted, the governing purposes of the various instructional programs of the "Alberta Composite High School," may be summarized as follows:

1. The fundamental social task of the school is to assist in the

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[12]Province of Alberta, Department of Education, Foundations of Education, Bulletin I (Edmonton: Queen's Printer, 1949), p. 6.

[13]Department of Education, Senior High School Handbook, 1965-66 (Edmonton: Queen's Printer, 1965); Department of Education, Program of Studies for Senior High Schools of Alberta (Edmonton: Queen's Printer, 1965); and Department of Education, Foundations of Education, op. cit.

[14]Province of Alberta, Report of the Royal Commission on Education (Edmonton: Queen's Printer, 1959).

transition of every young person placed in its care toward a desired adult status by developing the individual's maximum potentialities in socially accepted ways. Inherent in this assumption is the conviction that every child has a "universal" right to some educational opportunity.

2. The individual and the community is best served by the maximum accomplishment of "the general objectives of Secondary Education in Alberta." These objectives include the maximization of the individual's:
   (a) personal development and self-realization,
   (b) growth toward competence in citizenship and family living, and,
   (c) occupational preparation for intelligent and productive participation in economic life.

   This assumption presupposes that the needs of society and the individual in the light of social, civic, and occupational diversity, are best served through programs which result in divergent as well as common educational outcomes.

3. The educational tasks and objectives of the school are most effectively accomplished by means of differentiated programs which accommodate the legitimate interests, needs, and abilities of the individual student. Basic to this assumption is the recognition that every person brings to the educational enterprise unique as well as common sets of basic needs and human capacities.

4. Education, whether general or specialized, is a lifetime process. The school has an increasing responsibility, in the light of rapid development of human knowledge, social change, and technological advancement, to provide a program for each student which will qualify, prepare, and encourage them to continue learning, as an individual through other educational institutions and through training opportunities on the job.

In view of the "tasks" outlined above, an examination of the traditional success in the secondary schools of Alberta in terms of student retention and universal educational opportunity is revealing.

Black, in his study of 13,739 students writing Grade IX examinations in Alberta in 1955, reported: 22.1 per cent leave after Grade IX; 15.6 per cent leave at the end of Grade X; 16.2 per cent leave at the end of Grade XI; 10.9 per cent leave at the end of one year of Grade XII without a high school diploma; and 9.4 per cent return for a second year of Grade XII. Only 25 per cent will obtain a high school diploma and of this diploma group two-fifths obtain a matriculation standing. Only 10 per cent of Grade IX students obtain matriculation and only two-thirds of these enter university.[15]

This lack of "universal" success is further substantiated by studies at the Department of Education[16] and in the recent review of

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[15]D. B. Black, "A Study of Pupil Personnel in Alberta High School" (A special study for the Alberta Royal Commission on Education: mimeographed.) See Report of the Royal Commission, op. cit., p. 40.

[16]Department of Education, Special Services Branch, "A Study of the Success in High School of Students Who Wrote the June, 1965 Grade IX

studies on "Matriculation in Alberta," by Jenkinson and Coutts.[17]

The Needs of a Changing Society

A predominant characteristic of Canadian society has been "change." There is the acceleration of scientific and technological development, the growth of industrialization, and the shift from a predominant rural agriculture economy to an urban industrial and business economy. There are major population shifts and an increased mobility of workers. Greater numbers of women are being employed than ever before. The population continues to increase with increasing acceleration. Canada faces increasing competition on the world market with the emergence of the developing nations of the world and the rapid growth of industrialization in every possible country.

The technological and occupational needs of Canadian society are well documented through the efforts of the Federal Department of Labour's "Skilled Manpower Research Program" and "Advisory Committee on Technological Change." The purpose of the Skilled Manpower Research Program was to obtain information on the changing requirements for professional, skilled, and other types of manpower in Canadian industry; the existing sources of supply of such workers, and on the adequacy of existing

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Final Examination" (mimeographed report, Edmonton: Alberta Department of Education, 1961); and (in summary form) "Applying Grade IX Results," Alberta Testing and Research Bulletin (Edmonton: Department of Education, 1963).

[17]M. D. Jenkinson and H. T. Coutts, "Who Goes to University in Alberta?" Research Newsletter (Edmonton: Alberta Committee on Educational Research, University of Alberta, Special Newsletter, circa 1965).

training facilities in public institutions and industry.[18]

The research efforts of the "Advisory Committee on Technological Change" has been channeled into four main areas. The first has dealt with the extent and nature of technological changes and their effects on manpower requirements and training needs. The second was concerned with the manner in which selected groups of specialized workers acquired their skills. The third considered existing public and private training facilities in Canada. The fourth area was the study of occupational trends and the reasons underlying such trends. Of particular interest was a special study on the transition from school to work which examined the educational process as it affected occupational choice and employment experience.[19]

The characteristic of modern competitive business and industry is rapid technological change, the increased use of expensive and complex machines, and a need to raise productive capacity. In the world of "the past" human labour was a major asset, since "strong backs" were more in demand than "trained minds." It is obvious that such a situation no longer exists. In large segments of Canadian industry, the pattern of occupations has changed and there is a growing demand for more workers with higher and higher levels of skill and technical knowledge.

In the past decade, the fastest growing occupations have been those which require a high level of formal education and training. Those

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[18]Department of Labour, Technical and Vocational Training Branch, Technical and Vocational Education in Canada, I:1 (Ottawa: Summer, 1962), pp. 14-15.

[19]Ibid.

occupations experiencing the least growth are in the semi-skilled and unskilled categories. In 1900, 60 per cent of the labour force was employed in semi-skilled and unskilled fields. By 1960 this demand had declined to 30 per cent. The projection by 1980 is that semi- and unskilled labour will require only four per cent of the labour force.[20]

In Alberta there has been a growing awareness of the educational implications of the changing social and economic trends. In recent years, the relationship between social and economic well-being and the level of educational preparation has become increasingly apparent. The demands for increased amounts of education with higher levels of technological knowledge and greater diversity of skill are made explicit in The Report of the Alberta Royal Commission on Education;[21] the report of the conference on Education and Productive Society;[22] and through the annual publications of Occupational Trends and Employment Opportunities.[23]

The re-occurring thesis, of both research and expert opinion, has been that traditional forms of education have failed to equip sufficient numbers of young people to meet the requirements of new occupational opportunities and the increasing complexity of industry and business.

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[20] Department of Labour, Information Branch, "Meeting the Manpower Challenge of the 1960's" (Ottawa: Department of Labour). (Pamphlet.)

[21] Province of Alberta, Report of the Royal Commission on Education (Edmonton: Queen's Printer, 1959), pp. 13-46.

[22] H. R. Ziel (ed.), Education and Productive Society, Conference proceedings, University of Alberta (Toronto: W. J. Gage, 1964).

[23] Department of Education, Guidance Branch, Occupational Trends and Employment Opportunities (Edmonton: Queen's Printer, 1966).

Wilhelm's conclusion is that some form of "vocational preparation for all is a must."[24]

The Alberta Royal Commission on Education in 1959

A major influence on secondary schools and the development of vocational programs was the Alberta Royal Commission on Education. The Commission's conclusions, Report of the Royal Commission on Education in Alberta 1959, reflected the attempt to take into account not only the expectations of the "school's public," but also, the nature of the educative process.[25]

The nature of this investigation permits only the briefest summary of the Commission's findings that relate to the area of vocational education. The numbers in parenthesis refer to the Commission's recommendations that supports the statement. The Commission concludes that:

1. The curriculum must allow for differentiation of all levels of the school if pupils are to be retained for a minimum of ten years (19,29).
2. Public opinion suggests, "More emphasis was desired upon occupational guidance, training for a specific job, management of personal finances, and homemaking and handyman skills." (17, 33,80,102,120).

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[24]Fred T. Wilhelms, "Vocational Education," Bulletin of the National Association of Secondary-School Principals, XLIX:301 (Washington, D.C.: 1965), p. 4.

[25]Report of the Royal Commission, op. cit.

3. A clear cut distinction be made between vocational education and industrial arts. Courses must not attempt to serve a dual function (101,102,103).
4. Industrial arts offerings be elective, allowing student and parental choice, as to the exploratory courses desired (89,100).
5. Vocational education must develop saleable skill and knowledge acceptable to industry (101,102).
6. Vocational education be limited to decentralized regional centres and not an offering of every school (28,103,120).
7. Terminal programs be devised for pupils who by ability or disposition will leave school after age sixteen (29,30).

The Technical and Vocational Training Act of 1960

The catalyst to the increase of emphasis on vocational preparation was federal legislation, under the sponsorship of the Department of Labour, enacting the Technical and Vocational Training Assistance Act.[26] The legislation was designed to develop a total Canadian manpower training program as a means to overcome the problems of declining productivity and rising unemployment created by rapid technological and social change. In addition to financial assistance for training programs, the Act includes a provision for the co-ordination of effort and for research and development projects. The Act was implemented by means of the Technical and Vocational Training Agreement, to which all provinces signed accord.[27]

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[26] Technical and Vocational Education in Canada, op. cit., pp. 5-8.

[27] Ibid.; and "Technical and Vocational Training Agreement" (Edmonton: Department of Education) (mimeographed).

The agreement provides for federal contributions toward provincial expenditures for the facilities, services, and instruction of technical and vocational educational education programs.

The intention of the Act and the subsequent Agreement is reflected in a statement of the Minister of Labour to the provincial Deputy Ministers of Education, as quoted by Ford.

> Additional federal assistance has not been provided under this legislation to relieve or reduce the provincial government's responsibility in this field; rather it was designed to encourage and make possible the development of those programs which are required for the training of Canada's labour force.
>
> It is no longer good enough for us to have only a small proportion of our young people complete high school mainly with the thought of university in mind and still smaller proportion complete a technical or vocational program at the secondary school level and have the remainder find their life's vocation in the best way they can. We can no longer afford this waste of human resources.
>
> The pace of technological change is too rapid and competition for world markets is too intense to allow us to squander our most precious assets.
>
> The task before us is by no means a small one. To maintain full employment and an adequate place in domestic and foreign markets we must be able to compete with countries where the level of the skills of work forces is higher than in Canada.[28]

The Federal-Provincial Technical and Vocational Training Agreement defines technical and vocational education as any form of instruction, "the purpose of which is to prepare a person for gainful employment in any primary or secondary industry or in any service occupation or to increase his skill or proficiency therein. . .and requiring an understanding of the principles of science or technology and the application

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[28] C. R. Ford, "Technical and Vocational Education," Vocational Training Programs in Alberta School Systems (Edmonton: Department of Extension, 1962), p. 5.

thereof. . . ."[29] Within this definition, the Agreement contained specific provisions, which directly affected the development of vocational education at the secondary school level.

Program I: The Vocational High School Program defines the prescribed conditions whereby high schools receive capital assistance.

> This program covers those courses given as an integral part of high school education, in which at least one-half of the school time is devoted to technical, commercial and other vocational subjects or courses designed to prepare students for entry into employment by developing occupational qualifications. It may also include courses which provide students with an essential basis for further training after leaving regular high schools. . . .[30]

The impact of this unprecedented opportunity to give greater attention to occupational preparation provided by the Act and the Agreement, is in part reflected by the magnitude of the growth in buildings and equipment. In Alberta to December 31, 1966, the federal government contributed $81,482,517.00 towards the total provincial expenditure of $129,935,667.00 on facilities to provide 36,022 new student places. Included in the Province of Alberta total were over forty vocational high school projects with a new student capacity in excess of 25,000.[31]

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[29] Technical and Vocational Training Agreement, op. cit., p. 2.

[30] Ibid., p. 3.

[31] Department of Manpower and Immigration, Technical and Vocational Education in Canada, No. 10 (Fall-Winter, 1966-67), p. 52.

II. THE CONTEXT OF THE VOCATIONAL PROGRAMS[32]

Each program of the Alberta High School system contains a selected pattern of high school courses designed to provide a general education and to successfully develop special interests and abilities and to accomplish specialized career objectives.

The essential element of all vocational programs is the sequence of vocational education courses. Each vocational program contains a Vocational 12, 22, and 32 course sequence of thirty-five high school credits in one occupational area, such as Automotives, Commercial Art, or Graphic Arts.

All vocational programs are associated with a number of compulsory and elective courses which define the basic structure of a student's total high school program. A particular compulsory course is selected because its special educational qualities can make the greatest possible contribution toward the student's success in accomplishing the objectives of the particular program. Elective courses permit the student to meet

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[32]This investigation found a serious lack of published descriptive literature on the structure and operations of the vocational programs and courses in Alberta secondary schools which permit proper reference citation. Of necessity, much of the material in the remaining parts of this chapter has been abstracted from four sources, which are: Alberta Department of Education, Senior High School Handbook (Edmonton: Queen's Printer, 1966); Alberta Department of Education, Program of Studies for Senior High Schools of Alberta (Edmonton: Department of Education, 1965); and Educational Opportunities, a registration booklet containing a description of the courses and programs offered at Victoria Composite High School (Edmonton: Victoria Composite High School, 1967); as well as the observations of the investigator during visits to several composite high schools and to vocational education conferences.

special needs and to develop special abilities and interests within selected subject areas.

Each high school program is intended to tolerate a maximum degree of flexibility in course structure which permits alternative "educational standings" to be obtained. The typical alternatives in course structure associated with the various vocational programs is indicated in Figure 4. An important feature of the total instructional program of every "vocational student" is the concurrent emphasis on both specialized vocational courses and general education.

The general education includes essential or facilitative skills such as reading, writing, speech, numerical, and motor which are basic to further educational and intellectual development. In addition, this general education includes basic learnings in all significant areas of human knowledge. All vocational students are required to register in appropriate course sequences in the physical and biological sciences, the social sciences, mathematics, and English literature and language. All students must select additional elective courses from the humanities, foreign languages, art, music, and drama. The aim of this general education is to produce a vocational student who has mastered the basic educative knowledge and skills and who has learned how to acquire further knowledge, how to generalize from knowledge, and how to rationally apply knowledge.

A course. A course is the potential sequences of learning experiences or units of instruction, at a given grade level, from the content of a particular subject field. Each course is normally defined

GRADE X		GRADE XI		GRADE XII	
English 10	(5)	English 23 or Language 20	(5)	English 30 or 33	(5)
Social Studies 10	(5)	Social Studies 20	(5)	Mathematics 30 or 32	(5)
Physical Education 10	(5)	Mathematics 20 or 22	(5)	Physics 30 or 32	(5)
Mathematics 10 or 12	(5)	Science 20 or 22	(5)		
Science 10	(5)	AND ONE OF:	(20)	AND ONE OF:	(15)
		Automotives 12/22		Automotives 32 (A)	
		Beauty Culture 12/22		Beauty Culture 32 (A)	
		Building Construction 12/22		Building Const. 32 (T&A)	
		Commercial Art 12/22		Commercial Art 32	
		Drafting 12/22		Drafting 32 (T)	
		Electronics 12/22		Electronics 32 (T&A)	
		Electricity 12/22		Electricity 32 (T&A)	
		Food Preparation 12/22		Food Preparation 32 (A)	
		Graphic Arts 12/22		Graphic Arts 32	
		Machine Shop 12/22		Machine Shop 32 (T&A)	
		Performing Arts 12/22		Performing Arts 32	
		Welding 12/22		Welding 32 (A)	
Electives (Three)	(15)			Electives	(5)
Total Credits	(40)	Total Credits	(40)	Total Credits	(35-40)

NOTE: 1. Credit of one year advanced standing at the Institutes of Technology in programs indicated (T).
2. Credit of at least one year toward Apprenticeship in programs indicated (A).
3. Matriculation by completion of one additional year.

Figure 4. Typical alternatives in course structure associated with the Vocational Programs.

by authorized "Curriculum Guides" issued by the Department of Education of the Province of Alberta. The curriculum guides specify the course objectives and the course content for a given period of time together with related information, authorized text, and teaching methods involved.

Course standing. The standing or marks earned by the student describe the degree of success in a course and generally indicate the amount of knowledge and skill learned in that subject. The Department of Education issues a "transcript" which is the official statement of standing in individual courses and of the credits earned. Course standings are reported as either percentages or letter gradings. The letter gradings reflect a range of percentages as follows: H - 80 to 100 per cent, A - 65 to 79 per cent, B - 50 to 64 per cent, C - 40 to 49 per cent, and D - 0 to 39 per cent. A standing of not less than a "B" is normally the prerequisite to proceed to the next sequent course.

Course credits. Each course taken in high school has assigned to it a credit value. A course assigned five (5) credits involves approximately two hundred minutes of class time every week throughout the school year. To earn the credits attached to any course a student must achieve at least a "C" (40 per cent) standing. With reasonable effort students complete several courses and are able to earn thirty-five to forty credits each year. Course credits are accumulated towards the earning of the High School Diploma.

All high school programs give priority to the compulsory and optional courses required to complete the high school diploma during

three years of high school. The High School Diploma is the graduation certificate awarded by the Alberta Department of Education for successful work done in any senior high school. The minimum conditions for obtaining a High School Diploma are the successful completion of all of the following:

1. English - at least three courses including English 10 and English 30 or 33.
2. Social Science - at least two courses including Social Studies 10.
3. Mathematics - at least one course.
4. Science - at least one course.
5. Physical Education - Physical Education 10.
6. Fifteen credits in courses at the Grade XII level (including English 30 or 33).
7. One hundred High School Credits - complete the additional courses of an instructional program which totals at least one hundred high school credits.[33]

Students in a vocational program receive an appropriate Vocational Certificate when they have successfully completed a High School Diploma which contains not less than thirty-five high school credits in one vocational education 12/22/32 course sequence.

Additional educational standing, to the High School Diploma and Vocational Certificate, may be obtained within all Vocational Programs

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[33] Senior High School Handbook, op. cit., p. 25.

by the completion of the special course requirements specified by post high school educational institutions. For example:

1. Credit of one year advanced standing at the institutes of technology in programs indicated with (T) in Figure 4, page 27, provided credit in Physics 30 or 32 and a "B" standing in the Vocational 32 course is obtained.
2. Credit of at least one year advanced standing toward a standard apprenticeship program in programs indicated with (A) in Figure 4, page 27, provided a "B" standing in the Vocational 32 course is obtained.
3. Senior matriculation and university entrance after completion of one additional year. University entrance normally requires a High School Diploma which includes successful completion of six specified Grade XII academic courses.[34]

III. DIMENSIONS OF VOCATIONAL ACHIEVEMENT[35]

The vocational content includes both vocational courses and specialized academic courses which are intended to help the student to develop his occupational career in several ways:

1. By developing the specialized knowledge, skills, attitudes about materials, machines, and process that are characteristic of a broad occupational area from business, industry, or

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[34] Ibid., pp. 39-48 and 54-59.

[35] See footnote 32, supra, p. 25.

technology.

2. By extending the depth of knowledge in two or three academic disciplines which directly relate to the selected occupational cluster. For example, additional mathematics and physics courses are required of students registering in electronics technology programs.
3. By developing applicative techniques that have a sound theoretical orientation grounded in several basic academic disciplines. For example, the electronics student will direct his attention toward the application of previously acquired knowledge from several disciplines in the solving of theoretical and practical problems encountered within the electronic technology.
4. By providing the highest possible educational standing and specialized prerequisites to permit continued career development at other educational institutions or through on-the-job training programs after high school graduation. All vocational programs provide basic entrance requirements to the Institutes of Technology, apprenticeship, and (with required academic courses) university entrance. In addition, the majority of vocational programs are articulated in terms of one year advanced standing, with appropriate technical institute or apprenticeship programs.

The term "vocational education," when used in connection with the vocational programs of high school, is limited to the part which the high schools take or are able to take in training people for employment. Only

a part of the responsibility for vocational training falls to the public high school. The responsibility is to provide an introductory training in the skills and theory of a chosen occupation and not in all cases a fully competent worker.

The Vocational Education 12, 22, and 32 Courses

The unique feature of all vocational programs is the vocational education 12/22/32 course sequence. These courses are designed to develop the knowledge, skills, abilities, understandings, attitudes, and habits needed by individuals to enter and make progress in specific occupational careers on a useful and productive basis.

An integral and essential aspect of the vocational education courses is the environmental conditions found in the "shop laboratory." A uniqueness is reflected by the characteristic assignment of larger areas of physical space for vocational shops, the room design, and in particular the specialized nature of the industrial or business equipment. This environment simulates, as nearly as possible, the tools, machines, and other physical conditions typical of the occupational area, which is the subject field of a particular program. It is significant that the Technical and Vocational Training Agreement was specific in its requirement that vocational instructors be occupationally competent as journeymen, tradesmen, engineers, technicians, or equivalent and that they also be professionally trained.[36]

An important aspect of the vocational shop environment are the

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[36] Ford, op. cit., p. 14.

"live jobs." For example, students taking automotive courses learn by working on customer automobiles; the electronics students learn to apply the previously acquired theory by repairing actual television sets. In addition, the vocational shop normally contains specialized teaching devices such as visual models, mock-ups, and other demonstration units which attempt to reflect the materials, procedures, and processes basic to a given occupational cluster. This environment is frequently supplemented by field trips to actual business or industrial locations.

The distinctive features of the different vocational shop environments are illustrated in several publications on shop design and equipment. Of particular interest is the annual March issue of Industrial Arts and Vocational Education,[37] which reviews the logic, the layouts and equipment lists of alternative vocational shop "design approaches" for most of the different vocational programs.

Each Vocational 12, 22, and 32 course, which contain five, fifteen, and fifteen course credits respectively, is detailed by "Curriculum Guides" authorized by the Department of Education. The curriculum guides for each vocational course have statements of objectives and lists of performances and expectations that are associated with occupational competence in the particular craft or technology. For example, the "Program of Studies" for drafting requires instruction to:

1. Promote an appreciation of craftmanship in drafting.

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[37] Industrial Arts and Vocational Education, monthly September through June for instructors of Industrial Arts and Vocational Education courses (Washington, D.C.: American Vocational Association).

2. Work in an orderly and efficient manner.
3. Develop skills in lettering, mechanical drawing and sketching.
4. Provide practical knowledge and experience in the fields of metalwork and building construction.[38]

Similarly, the "Program of Studies" for Machine Shop requires instruction to:

1. Enable students to operate power machines efficiently, safely and accurately.
2. Acquaint students with the basic types, features and functions of machinery used in the machinist trade.
3. Develop desirable habits concerning safety and good working relationships; proper use of time and materials.
4. Develop high standards of workmanship.
5. Develop skills and knowledge required to interpret blueprints and to produce accurate drawings.
6. Make students familiar with different types of metal used in industry.[39]

The Criterion Problem

Vocational achievement refers, in a generalized sense, to a student's level of success in accomplishing the objectives of a particular vocational program or course. More specifically, the term "vocational achievement" may be defined as the evaluated level of

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[38] Program of Studies for Senior High Schools of Alberta, op. cit., pp. 175-77.

[39] Ibid., p. 168.

"correspondence" between a student's observed behaviour and some conceptualized model of ideal behaviour. It will be observed that the achievement dimensions of vocational courses are in terms of performances and expectations required to enter and make progress in the specific occupation on a useful and productive basis. A "student's achievement" is therefore evaluated in terms of demonstrated behaviour relative to typically competent persons in relevant occupational areas.

For the purpose of this investigation, the level of a student's vocational achievement was quantitatively described by the final course marks awarded in Automotives 22, Beauty Culture 22, Commercial Art 22, Commercial Foods 22, Drafting 22, Electricity 22, Electronics 22, Graphic Arts 22, Machine Shop 22, and Performing Arts 22.

There have been no reported studies on the evaluation procedures or relative weights given to "practical" and "theoretical" aspects in the context of the Alberta High School System. However, on the basis of discussion with instructors, and observations within the school investigated, several "highly subjective" conclusions were reached.

In practice, the evaluations of Vocational 22 course achievement is a composite of subjective and objective techniques employed by individual instructions. There was little evidence of any attempt to use standardized tests. All instructors indicated that marks reported on report cards during the year were scaled to have a class mean of between 50 to 60 per cent. These evaluations are subject to a range of variation, depending on the relative values and emphasis of these different individuals. In addition, the frequent use of written

examinations suggests that evaluations of actual vocational skills and knowledge may be strongly affected by the student's concurrent verbal abilities.

The indications were that the weight assigned to theoretical achievement as opposed to practical, ranged from about 40 to 60 per cent of the final mark. Commercial Foods 22 was the least theoretical and Electronics 22 appeared to have the greatest emphasis on the theoretical knowledge.

CHAPTER III

THE DIMENSIONS OF STUDENT APTITUDE

The purpose of this aspect of the investigation, as reported in this chapter, was threefold. The first purpose was to examine the general nature and meaning of student aptitude. The second was to describe the selected measures of student aptitude and critically review the literature for evidence of their predictive validity, and the third, to draw some tentative conclusions as to the utility of the assumed measures of aptitude as predictors of achievement in the vocational programs.

I. THE MEANING OF STUDENT APTITUDE

In the previous presentation, several studies were cited which supported the conclusion that future behaviour, and therefore achievement, is a function of the physical, intellectual, and personality factors that are the personal conditions of an individual. Successful achievement was equated to positive output behaviour, defined in terms of the intended outcomes or objectives of particular instructional programs. A basic assumption of this study is that the potential for successful achievement can be defined as "aptitude."

Aptitude was defined (after Bingham) in the Dictionary of Psychology as "a conditioned set of characteristics regarded as symptomatic of an individual's ability to acquire, with training some (usually

specified) knowledge, skill, or set of responses. . . ."[1] Super and Crites suggest that aptitude is not a single entity but rather a constellation of entities which enables a person to learn and may be different from that which enables another person to learn the same thing.[2]

Bennett et al. summarize the concept regarding aptitude as simply "a capacity to learn." They conclude that "aptitude embraces any characteristic which predisposes to learning, including intelligence, achievement, personality, interests, and special skills."[3] Remmers defines aptitudes as "present traits considered as predictors of future achievement."[4] Hahn and MacLean refer to aptitudes as latent potentialities, undeveloped capacities to demonstrate achievement.[5] On this basis, data from intelligence or achievement tests, school grades, or physical and personality traits can be interpreted as evidence of a student's aptitude if they have value as predictors of future achievement.

It may be concluded that at the practical level, only a vague distinction can exist between "aptitude" and "achievement." Adams et al. state that:

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[1]George K. Bennett, et al., Differential Aptitude Tests (New York: The Psychological Corporation, 1966), pp. 1-2.

[2]Donald E. Super and John O. Crites, Appraising Vocational Fitness (New York: Harper and Row, 1949), p. 71.

[3]Bennett, loc. cit.

[4]Georgia S. Adams, Theodore Torgenson, and Ernest R. Wood, Measurement and Evaluation for the Secondary School Teacher (New York: The Dryden Press, 1957), p. 87.

[5]Clifford P. Froehlich and Kenneth Hoyt, Guidance Testing (Chicago: Science Research Associates, 1959), p. 118.

> The real distinction between achievement and aptitude is in the purpose for which testing took place. . .whether the point of view is backward looking or forward looking, whether the concern is with the pupil's past or with his future.[6]

Thorndike and Hagen note that the achievement a person has gained in the past may be one of the most accurate indicators of the amount of further achievement he will acquire in the future.[7]

It must be noted that every measure of past achievement cannot be assumed to be a good test for aptitude until it has been validated in the same way as any other aptitude test. Super and Crites state: "An achievement test (or test of any type) can be used as an aptitude test only when there is a known relationship between the performance tested and the performance in which success is to be predicted."[8] However, to the extent that tests for knowledge, skill, intelligence, sensory-motor abilities, as well as interests or other motivational qualities, are measures of the capacity or potential for achievement, they may be viewed as evidence of aptitude.

From these perspectives, the "student's aptitude" includes all those innate or acquired conditions of the human organism which affect an individual's potential to acquire particular patterns of behaviour within instructional programs of the school. Student aptitudes are those capacities for performance which contribute toward successful achievement.

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[6]Adams, et al., op. cit., p. 88.

[7]R. L. Thorndike and E. Hagen, Measurement and Evaluation in Psychology and Education (New York: John Wiley and Sons, 1959), pp. 21-22.

[8]Super and Crites, op. cit., pp. 148-49.

Equally important, the term "student aptitude" implies an absence of those negative qualities of input behaviour which detract from positive behaviour in the particular instructional situation. The terms "readiness," "fitness," "talents," "potential" are frequently used in the literature, as alternatives to "aptitude" (as defined in this study) and appear to describe the same concept.

At the operational level, student aptitude can only be evaluated on the basis of observable behaviour or achievement. It is therefore a measure of performance and only by inference reflects the acquired states of expectation or interest. By definition, in this study, the scores obtained on the Grade IX Record, the Differential Aptitude Test, and the Kuder Preference Record-Vocational are assumed to be capable of providing quantitative evidence of student aptitude.

It must be noted that this operational definition of "aptitude for achievement" lacks the more precise scientific sense preferred by many psychologists and psychometricians. It must be stressed that this definition of aptitude and the use of these instruments does not necessarily imply that interest and achievement are synonymous with aptitude. Rather, it implies the probability that inherent in the scores of these tests are measures of aptitude which are related to vocational achievement.

II. THE PREDICTIVE VALUE OF THE ALBERTA GRADE IX RECORD

The "Grade IX Record" refers to the scores primarily derived from the "departmental examination" which have been administered at the end

of June each year to all Alberta Grade IX students.[9] The Grade IX Record includes an aggregate score and individual scores in reading comprehension, literature, language, social studies, mathematics, science, and the verbal and quantitative scores of the "Cooperative School and College Ability Test: Level 3."

The departmental examinations were developed, scored, and standardized by the Alberta Department of Education. The raw scores obtained from these examinations were scaled to maximum scores of 100. In the case of reading and literature the raw scores were combined to provide the final scaled score in literature. In the case of social studies and science, teacher ratings were combined with the examination score. The Aggregate score is the summation of the final scaled scores of the five examination subjects. The scaled scores were then converted to letter gradings and since 1956 to stanines. Figure 5 shows the relationship which exists between scaled scores, letter grades, stanines, and percentiles.[10]

Students' Grade IX performance level, as measured by the Department of Education's examination system, has typically been the basic allocation criteria within the high schools of Alberta. Both through

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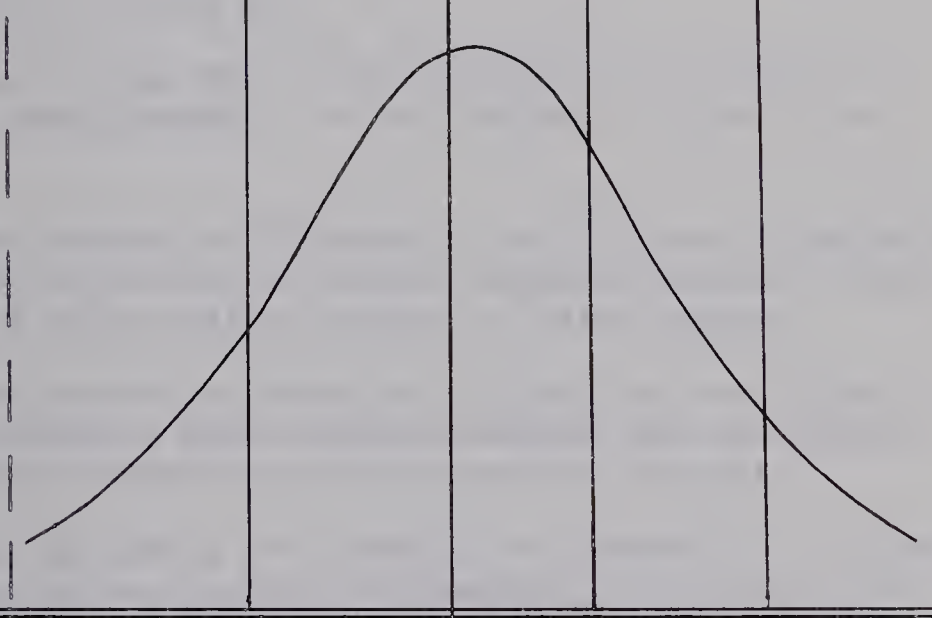
[9]For a systematic review of the nature and functions of the Alberta Grade IX examinations see appropriate sections in: R. S. MacArthur and S. Hunka, School Examination Practices and Standards in Alberta (Edmonton: The Advisory Committee on Educational Research, University of Alberta, 1960); and (in summary form, including recent developments), V. Nyberg, "The Changing Role of Examinations," Curriculum News Letter No. 22 (Edmonton: Department of Education, October, 1966).

[10]MacArthur and Hunka, op. cit., pp. 11-12; and Nyberg, op. cit., pp. 4-5.

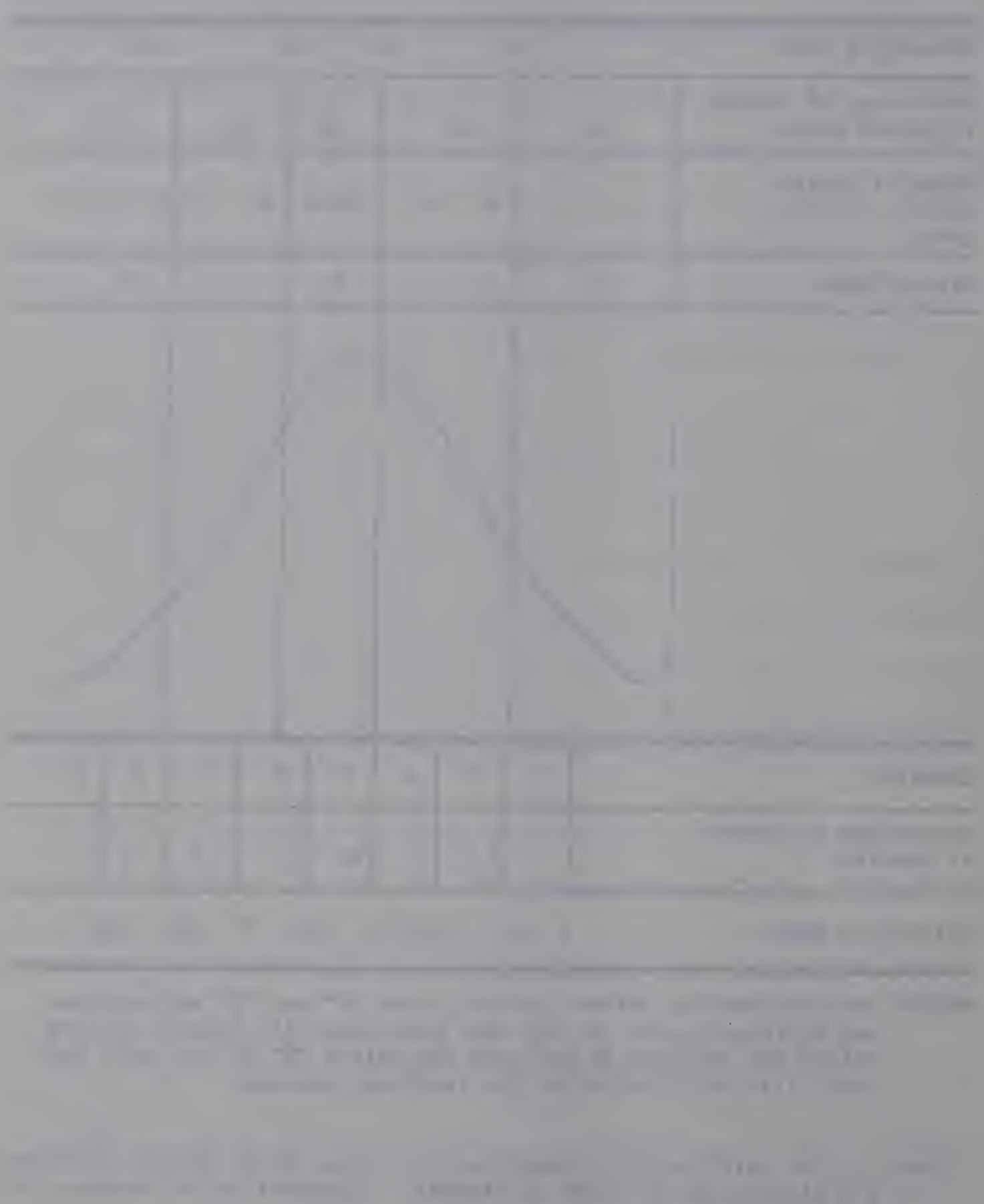
Percentile Rank	0	10	40	65	90
Percentage of Scores in Letter Grade	10	30	25	25	10
Range of Scaled Scores in Letter Grade	0 - 39	40 - 49	50-64	65 - 79	80 - 100
Letter Grade	D	C	B	A	H



Stanine	1	2	3	4	5	6	7	8	9
Percentage of Scores in Stanine	4	7	12	17	20	17	12	7	4
Percentile Rank	4	11	23	40	60	71	89	96	

NOTE: The relationship between letter grades "C" and "B" and stanines was different prior to 1962 when percentage of students falling within "C" equalled 20 per cent and within "B" 35 per cent, however, stanine distribution has remained constant.

Figure 5. The relationship between scaled scores, letter grades, stanines. and percentiles of Grade IX Students. (Source: as in footnote 10.)



regulation and practice, the Grade IX achievement record normally determines the right of entry to the high school, as well as the selection of courses and programs a student is entitled to register in. The implied predictive value of the student's Grade IX Record is reflected in the official statement of "guidance" indicated on the reverse side of the Grade IX Diploma issued by the Department of Education.

1. The letter gradings indicate the student's degree of success in the subjects taken in Grade IX.

2. A student who has secured "H" or "A" standing on all Grade IX subjects can succeed, probably, in any subject of Grade X and later grades.

3. A student who has secured a "B" standing on all Grade IX subjects has a fair chance of success in Grade X subjects but might have difficulty with a matriculation program in later grades.

4. A student who has secured a number of "C" gradings has slight chance of success with a matriculation program, but can benefit from other programs depending on aptitudes and interests.

5. A student who has secured a "C" standing in mathematics or science has slight chance of success with Mathematics 10 or Science 10 and should probably make other selections at the Grade X level.

6. If a student secured a "D" standing in any subject, it is very unlikely that he will succeed in the Grade X course in that subject.[11]

The predictive qualities of the Grade IX examination results have been the subject of numerous articles and research projects. Frequently, however, their pertinence to the major concern of this present investigation was so indirectly related that they proved to be of little value. The majority of the predictive studies encountered were concerned with

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[11]Alberta Department of Education, Senior High School Handbook, 1966-67 (Edmonton: Queen's Printer, 1966), pp. 36-37.

the validity of the Grade IX Record in estimating "academic" achievement within Alberta high schools or in estimating university success. Only a few of the investigations reviewed were concerned with criterion variables which could be considered closely related to the context of specialized vocational education. Of the references surveyed, no indication was found of any study having been concerned with the relationship of the Alberta Grade IX Record to later occupational success. The findings of the studies reported in the following section were considered to be pertinent to the present investigation.

The Special Services Branch, Department of Education, investigated the relationship that exists between Grade IX achievement and high school success. The sample used consisted of approximately 350 students in each of the nine aggregate stanine ranges and drawn by appropriate sampling methods from all Grade IX students who wrote the examinations in June, 1956. A major conclusion derived by this investigation is reflected in Table I which shows the probability for success in high school for Grade IX students classified by achievement aggregate stanine form. Other pertinent conclusions may be summarized as follows:

1. The aggregate stanine was as good a predictor of performance in any Grade XII subject as was the single corresponding Grade IX subject.
2. There is a low probability of a student achieving a higher score in a Grade XII subject than was achieved in the corresponding Grade IX subject.
3. Though students who were classified below stanine 5 have a

TABLE I

PERCENTAGE PROBABILITY OF HIGH SCHOOL SUCCESS FOR STUDENTS CLASSIFIED BY GRADE IX AGGREGATE STANINE

Performance Level	Aggregate Grade IX Stanine 1	2	3	4	5	6	7	8	9
Complete a full Grade X (30 credits or more)	9%	25%	55%	72%	90%	93%	94%	96%	97%
Complete a full Grade XI (65 credits or more)	3	9	27	45	63	77	86	91	92
Complete 100 Credits	0	0	5	13	30	48	66	80	87
Receive a Diploma	0	0	3	12	26	46	66	80	87
Matriculate	0	0	0	0	3	15	32	58	80

(Source: "Applying Grade IX Results," Alberta Testing and Research Bulletin, 1963).

> less-than-even probability of completing Grade XI and only a 0.3 per cent chance of matriculating, many succeeded in at least some of the Grade XII academic subjects.[12]

Gushaty investigated the relationship between Grade IX performance and success in the Three-Year Matriculation Program.[13] The sample consisted of the 551 students who entered this program in 1958 through 1963 at one Calgary school. The predictor was the summation of stanine scores (maximum stanine points = 54) in the six examination subjects of the Alberta Grade IX Record. A significant difference between means of graduates (N = 202) and non-graduates (N = 349), of 7.71 was reported. The predictor-criterion relationship was described by a probability table. The probability of success with a stanine total of 35 points is one in fifty; of 40 points is two in five; and of 45 points is four in five. Gushaty concluded that the minimum prerequisite to the Three-Year Matriculation should be a stanine total of 39 points.[14]

The intercorrelations reported by Black, as part of a larger study, reveals the positive, but differential, relationship of the variables of the Grade IX Record to achievement in certain Grade XII academic subjects. The sample of 119 was drawn from a larger experimental population of 529

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[12] Special Services Branch, Alberta Department of Education, "A Study of the Success in High School of Students Who Wrote the June, 1956 Grade IX Final Examinations" (Edmonton: Department of Education, 1961) (mimeographed); and (in summary form) "Applying Grade IX Results," Alberta Testing and Research Bulletin, Department of Education (Edmonton, 1963).

[13] For a description of the graduation requirements for "Matriculation" supra, p. 28.

[14] M. Gushaty, "The Three-Year Matriculation Program: A Study of the Present MP3 Entrance Requirements," Professional Development Bulletin, VI:4 (May, 1967), pp. 2-8 (Edmonton: Alberta Teachers' Association).

University of Alberta freshmen who completed Grade XII in 1956. A comparison of the correlation coefficients indicates that the three best predictors from the Grade IX battery would be:

1. For English XII: Reading (.613), Literature (.581), and Language (.505).
2. For Social Studies XII: Language (.614), Reading (.400), and Literature (.389).
3. For Science XII: Mathematics (.420), Language (.374), and Science (.298).
4. For Mathematics XII: Mathematics (.393), Science (.294), and Reading (.147).[15]

Some aspects of a study by Benedict appear to have relevance, to the extent that certain motor skills and other performances required in the vocational courses are similar to performances associated with typewriting and shorthand. In particular, Graphic Arts, and to a lesser extent, Drafting and Commercial Art utilize similar equipment and symbolic process as do these business education courses.

Benedict examined a number of variables including the Grade IX Record and Typewriting 10 and Shorthand 10. The sample consisted of 302 Grade X and 171 Grade XI students from Edmonton high schools. The intercorrelation matrix reveals that of the Grade IX variables:

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[15]D. B. Black, "A Comparison of the Performance on Selected Standardized Tests to That on the Alberta Grade XII Departmental Examination of a Select Group of University of Alberta Freshmen," The Alberta Journal of Educational Research, V:3 (Edmonton: The Committee on Educational Research, University of Alberta, September, 1959), pp. 180-90.

1. For the Grade XI sample, the best two predictors of subsequent achievement in Typewriting 10 were Social Studies (r = .292) and Science (r = .261).
2. For the Grade XI sample, the best two predictors of Shorthand 20 were Science (r = .286) and Social Studies (r = .277).
3. For the Grade X sample, the best two predictors of Shorthand 10 were Science (r = .418) and Language (r = .397). It is interesting to note that Social Studies was third highest (r = .370).[16]

A study by Campbell, "Predicting Success in Vocational Subjects," is particularly pertinent to the present investigation, both in its statistical design and in its area of concern.[17] Campbell examined the relationship between Grade IX examination performance and success in certain Grade X vocational subjects. The predictive variables used were the "Alberta Department of Education" scores, in stanine form in Reading, Literature, Language, Social Studies, Mathematics, Science, and the Verbal and Quantitative School and College Ability Tests. The criterion variables were the final results in the selected vocational courses of 443 students so registered in one composite high school during any of three school terms.

Of the Pearson Product-Moment correlation coefficients derived

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[16]Margaret I. Benedict, "Criteria for Predicting Shorthand Success" (unpublished Master's thesis, The University of Alberta, Edmonton, 1964).

[17]Theodore R. Campbell, "Grade Nine Marks as Predictor Criteria for Success in Selected Vocational Subjects" (unpublished Master's thesis, The University of Alberta, Edmonton, 1966).

between each of the eight predictor variables and the selected vocational course, the most efficient single predictors of success were found to be: for Automotives 12 (N = 221) - Science (.490); for Beauty Culture 12 (N = 30) - Quantitative SCAT (.424); for Carpentry 12 (N = 85) - Mathematics (.370); for Commercial Foods 12 (N = 12) - Quantitative SCAT (.283); for Drafting 12 (N = 387) - Mathematics (.392); for Electricity 12 (N = 113) - Science (.605); for Graphic Arts 12 (N = 101) - Science (.473); for Pipe Trades 12 (N = 52) - Social Studies (.393); and for Sheet Metal 12 (N = 86) - Mathematics (.428).[18]

Campbell found, using Step-wise Multiple Regression Analysis and Analysis of Variance, the best combinations of predictors of success were:

1. For Automotives 12: Science (24.05%), Mathematics (2.57%), Literature (negative 1.69%), and Verbal SCAT (1.11%), accounting for 29.43% of variance.

2. For Beauty Culture 12: Quantitative SCAT (18.03%), and Mathematics (negative 13.69%), accounting for 31.72% of variance.

3. For Carpentry 12: Mathematics (13.69%), Science (negative 4.37%), and Quantitative SCAT (1.01%), accounting for 19.08% of variance.

4. For Commercial Foods 12: Language (negative 9.12%), Quantitative SCAT (14.30%), and for Social Studies (negative 24.16%), accounting for 47.58% of variance.

5. For Drafting 12: Mathematics (15.40%), and Science (2.68%), accounting for 18.07% of variance.

6. For Electricity 12: Science (36.63%), Quantitative SCAT (3.92%), and Reading (negative 1.79%), accounting for 42.34% of variance.

7. For Graphic Arts 13: Science (22.40%), Mathematics (2.39%), and for Literature (1.68%) accounting for 26.47% of variance.

8. For Pipe Trades 12: Social Studies (15.47%), Mathematics (3.88%), and for Reading (1.11%), accounting for 20.45% of variance.

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[18] Ibid., p. 67.

9. For Sheet Metal 12: Mathematics (18.38%), Quantitative SCAT (negative 4.22%), and for Language (5.58%), accounting for 28.18% of variance.

Campbell's investigation, while supporting the hypothesized relationship between Grade IX performances and vocational subject success, does not provide evidence of a high predictive power from either the single predictive elements or from the possible combinations of the predictive elements. Because of low student registration (N = 12), results associated with Commercial Foods 12 are not significant. At the .05 levels of confidence, the use of combinations of predictors generally provided small gains, in the order of two per cent to five per cent, over the best single predictive variable.[19]

In part, the relatively low relationships reported by Campbell may result from the exploratory nature of the Grade X vocational courses. In the school from which the sample was taken, individual students may take several of these different five-credit vocational courses, for both elective and allocation purposes. This vocational exploratory experience is utilized by the school and the student to determine which of the alternative programs should be pursued in later grades. The differential variations in individual interest or motivation toward the different vocational 12 courses the individual student concurrently registers in, may contribute a significant variation in the measured predictive relationship.

The Special Service Branch, Department of Education, analyzed the

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[19] Ibid., pp. 67-83.

Grade IX performance of 333 students in their first year, during 1960-61, at the Southern Alberta Institute of Technology as part of a larger student background analysis. All of these students completed Grade IX in 1956 or later and all but 11.3 per cent spent at least three years in high school, with 45 per cent holding a High School Diploma. The relationship between Grade IX performance and success in each of twenty Institute courses was analyzed by means of a frequency distribution of the categories of achievement ("Fail," "Pass," and "Honors"), classified by aggregate stanine level. The relationship found is reflected in the generalized summary reported in Table II, which follows. The conclusion of the study was that "there seems to be a relation between Grade IX success and Technical Institute success." However, it must be noted, that because of low numbers of students in some courses (range between four and forty: mean = 16.6), and an inadequacy of the reported statistical treatment, the conclusions of correlation must be considered as extremely tentative.[20]

Black (1959b), as part of a series of related studies concerned with predicting successful achievement at university, examined the predictive qualities of the Grade IX Record. The sample used was 529 students who entered the University of Alberta in the fall of 1956 and who had participated in a special Grade XII testing program in May 1956. The criterion variables were the freshmen results in a variety of Arts, Sciences, Education, and Engineering courses. Black reported zero order

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[20] Special Services Branch, Alberta Department of Education, "A Study of the High School Background of the First-Year Class of 1960-61 at the Calgary Institute of Technology" (Edmonton: 1962) (mimeographed); and (in summary form,) Alberta Testing and Research Bulletin, op. cit.

TABLE II

SUCCESS AT TECHNICAL INSTITUTE FOR STUDENTS
CLASSIFIED BY GRADE IX AGGREGATE STANINE

Grade IX Aggregate Stanine	Performance at Institute			
	Fail	Pass	Honors	Total
8 - 9	1	20	6	27
6 - 7	17	114	10	141
5	20	66	2	88
3 - 4	30	42	0	72
1 - 2	3	2	0	5
TOTAL	71	244	18	333

Source: "Applying Grade IX Results," Alberta Testing and Research Bulletin, 1963.

correlation coefficients which range from .057 to .548 and multiple correlation coefficients which range from .349 to .614 between predictors and criterion. Mathematics IX made the greatest contribution to prediction, followed by Literature IX, Science IX, and Language IX, in order of frequency of contribution. The relationship of the best weighted combination of Grade IX variables to university average was .408 (R), and to Engineering average was .363 (R). Black's conclusion was that the student's performance on the Grade IX Record is of real value in prediction of university courses, particularly when used in the form of

multiple prediction equations.[21]

The significance of the above cited study (Black 1959) is enhanced by findings reported by Black (1960) in a related study which is based on the identical sample. Black noted that the "Engineering Average" includes such courses as drafting, survey field work, and engineering mechanics. He noted in particular that in Survey Field Work (C.E. 6), where "physical skills" predominate, validity coefficients drop when the predictors are measures of academic achievement. The implication to the present study, and to the traditional use of only academic achievement for student allocation is important.[22]

The Cooperative School and College Ability Test

Since 1957 the "Cooperative School and College Ability Tests: Level 3" (SCAT) have been used as an integral part of the Alberta Grade IX examinations system to measure general scholastic aptitude. The Department of Education provides directly to schools "normalized" scores, in percentile and stanine form, for both the Quantitative and Verbal SCAT tests.

The SCAT test series were developed by the Cooperative Test Division of Educational Testing Services in 1955 on the recommendations of an advisory board of educators and psychologists. These tests were

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[21] Donald B. Black, "The Prediction of University Freshman Success Using Grade IX Departmental Examination Scores," The Alberta Journal of Educational Research, V:4 (December, 1959), pp. 229-39.

[22] D. B. Black, "The Prediction of Freshman Success in the University of Alberta From Grade XII Departmental Results," The Alberta Journal of Educational Research, VII:1 (March, 1960), pp. 38-53.

designed "to aid in estimating the capacity of a student to undertake the next higher level of schooling." The tests are intended to measure "school learned abilities" rather than indirectly measured psychological characteristics. The development of the SCAT was based on three assumptions:

1. The best predictor of academic performance is past achievement;
2. The verbal and quantitative skills, which are acquired in school, are critical pre-requisites for success throughout the range of general education; and
3. That measures based on abilities, rather than tests of general intelligence, are more easily interpreted to students and parents as they can be related to commonly known school subjects.

The SCAT is described as measuring four kinds of acquired abilities: verbal comprehension; manipulating numbers and number concepts; sentence comprehension; and quantitative problems.[23]

Many of the studies reviewed, which utilize the SCAT as predictor variables, were related to academic criteria at the post-high school level. For example, Lewis found in a prediction study of the first quarter grade point average of 1,158 men and 840 women at the Southern Illinois University, that the SCAT (Form 1-A), yielded the largest zero order correlation from the battery of eleven predictor variables.[24] Similarly, Black found

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[23]Cooperative Test Division, Examiner's Manual, Cooperative School and College Ability Tests (Princeton Educational Testing Service, 1957), pp. 3-5.

[24]J. W. Lewis, "Utilizing the Stepwise Multiple Regression Procedure in Selecting Predictor Variables by Sex Group," Educational and Psychological Measurement, XXII:2 (1962), p. 401.

a positive relationship between SCAT scores and success of a selected group of University of Alberta freshmen.[25]

In several studies reviewed, which used criteria within the context of the secondary school, a positive relationship between SCAT and achievement level was noted. Chabassol noted that a low SCAT profile was a characteristic of under-achievers.[26] Black found a positive relationship existed between SCAT: Level 3 and performance on the Alberta Grade IX departmental examinations, and between SCAT and principal's rating of achievement.[27] In a second study, Black noted the positive relationship between SCAT and the achievement on Grade XII departmentals to be for Quantitative in the range of (r) .198 to .451 and for Verbal in the range of (r) .195 to .674.[28]

The previously cited study by Campbell found significant positive relationships between verbal and quantitative SCAT scores for the criterion Automotives 12, Beauty Culture 12, Drafting 12, Electricity 12, Graphic Arts 12, and Pipetrades 12. Campbell found that for the criterion Carpentry 12, Sheet Metal 12, and Commercial Foods 12, there was no significant relationship between the SCAT scores and the success level.

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[25]Black, 1959, op. cit.

[26]D. J. Chabassol, "Correlates of Academic Underachievement in Male Adolescents," Alberta Journal of Educational Research, V:2 (June, 1959), pp. 130-46.

[27]D. B. Black, "A Study of the Relationship of Grade IX Departmental Examinations," Alberta Journal of Educational Research, IV:4 (December, 1958), pp. 227-36.

[28]Black, 1959, loc. cit.

Generally the positive relationships found by Campbell were of a low order in the range of (r) .11 to .42.[29]

Benedict used the Verbal and Quantitative SCAT scores as part of a predictive battery of achievement in certain Grade X and Grade XI business education subjects, in Edmonton secondary schools. She indicated, for the Grade X sample (N = 302), a zero order correlation of .07 for the Verbal SCAT and a correlation of .28 for the Quantitative SCAT with the criterion Shorthand 10. For the Grade XI sample (N = 171), Benedict reports Verbal SCAT correlated with: Shorthand 10 (r = .11), Typing 10 (r = .13), Shorthand 20 (r = .25); and Quantitative SCAT with: Shorthand 10 (r = .20), Typing 10 (r = .18), and Shorthand 20 (r = .17).[30]

It may be concluded from the cited references, and others reviewed in earlier sections, that while SCAT is positively related to subsequent academic achievement, its relationship to non-academic or vocational endeavors in the secondary schools has not been strongly established. This conclusion is supported by Green who notes that the SCAT series are best described as "academic aptitude tests" and represent a "good general I.Q. test from which one cannot legitimately calculate I.Q.'s."[31] Super and Crites note "the validity of the SCAT is restricted to the educational setting as yet, since its relationship to criteria of vocational success has not been determined."[32]

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[29]Campbell, loc. cit. [30]Benedict, loc. cit.

[31]Russel F. Green (review in) The Sixth Mental Measurements Yearbook (New Jersey: The Gryphon Press, 1965), pp. 451-53.

III. THE PREDICTIVE VALUE OF THE DIFFERENTIAL APTITUDE TEST BATTERY

The Differential Aptitude Test Battery (DAT), developed in 1947 by Bennett, et al. (1959 and 1966) and updated in Forms "L" and "M" in 1963, represents one of the more generally used standardized aptitude test batteries for students in grades eight through twelve of the secondary school.

The DAT battery includes eight tests yielding separate scores. The sub-tests, together with a much oversimplified content analysis abstracted from the "Manual," are as follows:

1. The Verbal Reasoning test is intended to measure the ability to understand concepts framed by words and to generalize constructively where complex verbal relationships and concepts are important.
2. The Numerical Ability test is intended to measure understanding of numerical concepts and relationships and the ability to manipulate quantitative materials.
3. The Abstract Reasoning test is intended as a non-verbal measure of reasoning ability from abstract figure patterns and of ability to perceive relationships among objects.
4. The Space Relations test is intended to measure ability for structural visualization and perception of objects in three-

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[32] Donald E. Super and John O. Crites, Appraising Vocational Fitness (New York: Harper and Row, 1962), p. 120.

dimensional space and "ability to deal with concrete materials through visualization."

5. The Mechanical Reasoning test is intended to measure understanding of mechanical and physical principles in familiar situations and ability to reason in mechanical situations.
6. The Clerical Speed and Accuracy test is intended to measure speed of response in simple perceptual tasks.
7. The Language Usage-I: Spelling test is intended as a measure of basic spelling skills.
8. The Language Usage-II Grammar test is intended as a measure of ability to distinguish between good and bad grammar, punctuation and word usage. In Forms A and B, Language Usage II was called Sentences.[33]

The validity and reliability of the DAT test for predictive and, to a lesser extent, for discriminative functions within the secondary school, is well documented by Bennett et al.,[34] Super and Crites,[35] Thorndike and Hagen,[36] as well as countless other educational and psychological publications. There appears to be agreement that predictive relationships exist between DAT scores and success in both academic and nonacademic aspects of the normally constituted high school program. An

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[33]George K. Bennett, Harold G. Seashore, and Alexander G. Wesman, Manual for the Differential Aptitude Tests (New York: The Psychological Corporation, 1966).

[34]Ibid. [35]Super and Crites, op. cit., pp. 339-49.

[36]Thorndike and Hagen, op. cit., pp. 251-55.

interdependence between the tests is noted.

Bennett et al. reviews the research, involving samples on a nation-wide (U.S.A.) basis, of more than fifty thousand cases, used for the re-standardization and development of the present DAT Forms L and M. Table III abstracts, in summary form, the more pertinent relationships to academic success in high school established by Bennett.[37]

Doppelt, Seashore and Odgers report on an investigation of the predictive relationship between DAT and instructor success ratings in the two-year Machine Shop and Auto Mechanics Courses. Seven Ohio schools participated in the study. The DAT was administered to the students at the beginning of Grade XI and the ratings were obtained at the end of Grade XII. The five categories of evaluative criteria used were successful performance in: (1) Understanding Trade Information; (2) Job Know-How; (3) Quality of Work; (4) Quantity of Work; and (5) Total Rating (over-all performance). The instructor ratings were made on a five-point scale, 1 - Inadequate, 2 - Poor, 3 - Average, 4 - Good, and 5 - Excellent. Triseral coefficients were used to describe relationships.[38]

For Auto Mechanics students, no predictive evidence between DAT and over-all performance was found. Some relationship was established between the rating on "Understanding Trade Information" and predictor tests, Language Usage-Spelling (.38), Abstract Reasoning (.36), Language

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[37]Bennett, op. cit., Section 5, pp. 1-57.

[38]J. E. Doppelt, H. G. Seashore and J. G. Odgers, "Validation of the Differential Aptitude Tests for Auto Mechanics and Machine-Shop Students," Personnel and Guidance Journal (May, 1959), pp. 648-55.

TABLE III

SUMMARY OF VALIDITY COEFFICIENTS BETWEEN DIFFERENTIAL APTITUDES AND PERFORMANCE IN SELECTED ACADEMIC SUBJECT AREAS

Subject (Grades 8-12)	Sex	Correlation (median r) Coefficients								
		VR	NA	VR+NA	AR	CSA	MR	SR	SPELL.	GRAM.
English	Boys	.49	.47	.54	.38	.27	.16	.29	.45	.50
	Girls	.55	.52	.60	.45	.28	.28	.31	.48	.55
Mathematics	Boys	.38	.50	.50	.39	.20	.23	.28	.27	.38
	Girls	.41	.53	.54	.43	.20	.26	.32	.32	.40
Science	Boys	.45	.44	.52	.38	.24	.29	.34	.36	.44
	Girls	.54	.51	.59	.42	.25	.28	.34	.40	.48
Social Science	Boys	.46	.46	.52	.34	.24	.16	.27	.38	.48
	Girls	.52	.52	.58	.40	.28	.27	.33	.45	.50

(Source: Manual for the Differential Aptitude Test, Section 5, 1966)

Usage-Sentences (.34), and Numerical Ability (.33). For Machine Shop students, the predictive relationships for "over-all performance," from Mechanical Reasoning was (.47), Space Relations (.46), and Abstract Reasoning (.31). The investigators concluded that these relationships were sufficiently high to permit useful predictions from the expectancy tables developed which discriminate on a "three category success" scale. Because of the number of different instructor raters involved and the subjective nature of some of the rating scales utilized, the evidence from this investigation must be viewed with some caution.[39]

Stoughton considered the effectiveness of DAT in predicting success of 729 grade nine students from ten Connecticut technical schools. The criteria of success were Grade IX and Grade XI marks in English, social studies, science, mathematics, and blue print reading and in five shop areas: automotives, carpentry, drafting, electrical, and machine. Using appropriate correlation techniques Stoughton found that:

1. Verbal Reasoning and Numerical Ability tend to have a relatively high relationship to success in all general education and shop courses.
2. Verbal Reasoning, Numerical Ability and Abstract Reasoning were most useful for prediction of success at the Grade XI level.
3. Clerical Speed and Accuracy and Spelling were of little significance in prediction.

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[39] Ibid.

4. Abstract Reasoning, Space Relations, and Mechanical Reasoning were useful for predicting shop success.

Stoughton concluded, "The relationships of DAT scores to success in the Connecticut technical schools are such that the tests can be used for predicting probable success in the school program and, to a limited extent, for differential prediction."[40]

Halsey investigated the value of the DAT Numerical Ability, Sentences, and Mechanical Reasoning tests as predictors of the first-year average in Building Construction, Electrical, Industrial Chemistry, and Mechanical Technologies of a two-year college in New York State. As predictors, in addition to these DAT scores, he used a "high school index" which resulted in a multiple correlation coefficient of .601 (N = 389). Halsey concluded that the inclusion of the selected DAT scores into the prediction equation would result in an improvement in prediction of ten per cent over using the high school index alone.[41]

Few studies of the predictive validity of the Differential Aptitude Tests are available for occupational criteria outside of the educational context. Two follow-up studies by Bennett and others attempted to provide some evidence of validity regarding occupational areas. For example, they reported that persons who are employed:

1. Males in Mechanical, Electrical, and Building Trades (N = 66)

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[40]Bennett, op. cit., Section 5, pp. 51-52.

[41]H. Halsey, "The Predictive Value of Certain Measures Used in Selecting Freshmen for the Technical Curricula in a Community College" (unpublished Doctoral dissertation, New York University, 1956).

peak in Mechanical Reasoning and drop in verbal skills.

2. Males "Various Skilled" (baker, butcher, etc.,) (N = 26) drop in Numerical Ability, Space Relations and Abstract Reasoning.
3. Female Stenographers (N = 140) peak in Spelling scores.
4. Female "Various Skilled" (Beauty Operator, Nurses' Aid, etc.) (N = 45) peak in Mechanical Reasoning and Space Relations.[42]

It must be noted, that the above studies lack criterion measures and are at best descriptive. No pertinent study was discovered, by this present investigation, which provided evidence of predictive validity in terms of occupational success. Schutz, in a recent critical review of DAT, notes this major fault that "adequate occupational validity and normative data are lacking."[43]

IV. THE PREDICTIVE VALUE OF THE KUDER: VOCATIONAL

The Kuder Preference Record: Vocational, Form C (Science Research Associates, 1960) is one of the most widely-used interest inventories As developed in 1939, and modified to its present form in 1948, the Kuder-Form C was designed for use with both sexes of high school, college students, and adults.

The content of the Kuder-Form C is in the form of triads of items

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[42]G. K. Bennett, "The DAT--A Seven-Year Follow-Up," Test Service Bulletin No. 49 (The Psychological Corporation, November, 1955); and G. K. Bennett, H. G. Seashore, and A. G. Wesman, "Aptitude Testing, Does It Prove Out in Counseling Practice?" Occupations (1952), 30), pp. 584-93.

[43]Richard E. Schutz, The Sixth Mental Measurements Yearbook, op. cit., pp. 768-69.

or sets of activities to which the examinee, through forced choice, indicates his first and last preference. Each set of items reflects three or more different types of interests. In all, the "Kuder" measures ten clusters or general areas of interest which can be correlated to the known interest profiles of occupational reference groups. A verification scale is included to identify careless responses. The interest areas of the Kuder-Form C result in ten separate scores and are classified as follows:

1. Outdoor: Indicates a preference for work that keeps one outside most of the time, usually dealing with animals and growing things.
2. Mechanical: Indicates a preference for work with machines and tools.
3. Scientific: Indicates a preference for discovering new facts and solving problems.
5. Persuasive: Indicates a preference for meeting and dealing with people, and promoting projects or things to sell.
6. Artistic: Indicates a preference for doing creative work with one's hands. It is usually work that has "eye appeal" involving attractive design, color, and materials.
7. Literary: Indicates a preference for reading and writing.
8. Musical: Indicates a preference for going to concerts, playing instruments, singing, or reading about music and musicians.
9. Social Service: Indicates a preference for helping people.
10. Clerical: Indicates a preference for office work that requires precision and accuracy.[44]

Bennett et al., report on a study intended to describe the relationship between Kuder-Vocational and the DAT. The students, 169 boys

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[44]Science Research Associates, Administrator's Manual Kuder Preference Record (Chicago: Science Research Associates, 1960), pp. 2-3.

and 167 girls of an Ames, Iowa High School were given both. Only two pairings, the Kuder Mechanical Interest and DAT Mechanical Reasoning, and Kuder Scientific and DAT Mechanical Reasoning revealed any consistent and significant relationships (correlations in the order of r = .32 to r = .45). The conclusions, Kuder interest categories have little to do with measured aptitudes.[45]

Frandsen investigated the relationship between general achievement in related courses and level of Kuder interest for 137 high school seniors. He found a relationship (rho = .27) between ranks on Kuder and parallel achievement. In particular, Frandsen found a significant interest-achievement relationship between scientific and computational interests and related course achievement. He also notes a relationship between the Kuder and literature and social studies.[46]

Baggaley investigated the use of Kuder scores in determining the academic interests of 185 first-year college students. The students were classified by their major field of concentration, the natural sciences or humanities. The discriminant function was used to show that the resulting means of the two groups were significantly different at the .01 level with only 13.6 per cent of natural science students falling below the critical score and 14 per cent of humanities students obtaining a higher score. Baggaley concluded "that the Kuder scores provide a sound basis for

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[45] Bennett et al., op. cit., Section 8, p. 1 and Appendix A, p. 17.

[46] A. N. Frandsen, "Interests and General Educational Development," Journal of Applied Psychology, XXXI (1947), pp. 57-66.

differentiating students who propose to concentrate in different academic fields."[47]

The relationship of the Kuder-Vocational to achievement in an aircraft design class of twenty "semi-technical" students was one aspect of a larger study by Case. He found that individuals having a high computational interest as measured by the Kuder were more likely to be successful in a design class of this nature ($r = .40$).[48]

Motto investigated the use of interest scores from the Kuder-Vocational in predicting success in vocational programs at Michigan's Veterans' Trade School. A group of ($N = 40$) successful students and a second group ($N = 40$) of unsuccessful students randomly selected, were utilized. The resultant Kuder profiles were characterized by an absence of scores which fell beyond the highest and lowest quartiles. Motto concluded that none of the Kuder scales significantly discriminated between successful and unsuccessful vocational trainees.[49]

A number of studies on the relationship between Kuder-Vocational scores and school achievement are reviewed by Super and Crites. Triggs (1943) found significant correlations between scientific interest and general science achievement and between literary interest and achievement

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[47]Andrew R. Baggaley, "The Relation Between Scores Obtained by Harvard Freshmen on the Kuder Preference Record and Their Field of Concentration," Journal of Educational Psychology, XXXVIII (1947), pp. 421-27.

[48]H. W. Case, "The Relationship of Certain Tests to Grades Achieved in an Industrial Class in Aircraft Design," Educational and Psychological Measurement, XII:1 (1952), p. 90.

[49]J. J. Motto, "Interest Scores in Predicting Success in Vocational School Programs," Personnel and Guidance Journal, XXXVII (May, 1959), pp. 674-76.

in English literature. Yum (1942) found correlations between literary interest of men and computational interests of women and grade average. Thompson (1944) found no relationship between mechanical interests and a dental practicum. Lang and Perry (1953) found only low correlations (r's ranged .18 to .21) between Kuder scores and the four-year average of 172 engineering students. From these and other studies reviewed by Super and Crites they conclude:

> In schools and colleges the Kuder does seem to have real possibilities even for the prediction of success in courses, for scores are significantly related not only to the completion of training, . . .but also to grades in some appropriate subjects, specifically the scientific, mathematical, and literary. . . .[50]

The extent of the case for using Kuder as a basis for differentiation by occupation is presented by Kuder in the sixth edition of the "Manual." Kuder cites Travis as reducing the resulting 212 occupational profiles into the "41 homogeneous occupational families," in stanine form, that are used in the seventh edition of the manual. Pertinent to this present research, for example, are the typically high (stanine 6-9) means of:

1. Mechanical Interest. Manual tradesmen (N = 1,111), manufacturing foremen (N = 399), professional engineers (N = 1,557), mechanical maintenance occupations (N = 346), and manual clerks, male (N = 280).
2. Computational Interest. Civil engineers (N = 31), manual clerks, male (N = 280), office machine operators, female

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[50] Super and Crites, op. cit., pp. 461-92.

(N = 115).

3. Scientific Interest. Chemists (N = 54), pharmacists and laboratory technicians (N = 261), professional engineers (N = 1,557).
4. Persuasive Interest. Salesmen and sales managers (N = 2,451), customer and employee contact workers, female (N = 1,223).
5. Artistic Interest. Commercial artists and photographers (N = 69), and office machine operators, female (N = 115).
6. Literary Interest. Writers (N = 113), expressive arts occupations (N = 58).
7. Musical Interest. Musicians and music teachers (N = 169), customer and employee contact workers, female (N = 1,223) and general office workers and teachers of same (N = 1,056).
8. Social Service Interest. Religious, social and educational workers (N = 386).[51]

A Concluding Observation

The function of this chapter was to define the meaning of aptitude, to describe the selected measures of aptitude, and to review the literature for evidence of their predictive validity in situations having pertinence to the Vocational Programs and Courses under consideration.

Aptitude was defined as the potential for positive behaviour or learning. The assumed measures of aptitude were the scores from the

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[51] Science Research Associates, "Manual" op. cit., pp. 5-23; also see sixth edition of the "Manual."

Grade IX Record, the Differential Aptitude Test, and the Kuder Preference Record. Because of the magnitude of literature and research available on predictor variables, the review was limited to studies considering these specific measures of aptitude as predictors.

The predictive value of the Grade IX Record for estimating future academic success at both the high school and post-high school level was supported. Less support was found when criterion involved technical or vocational courses with content involving a higher degree of nonacademic performances or physical skills. The contribution of Science IX to prediction, both in frequency and in size of reported relationship, was generally noteworthy in the studies reviewed. To a lesser extent so were the predictive contributions of quantitative abilities, as measured by Mathematics IX or Quantitative SCAT.

The predictive value of the Differential Aptitude Tests, both for academic and nonacademic criteria within the context of schools received research support. Generally Verbal Reasoning and Numerical Ability tended to have a relatively higher relationship to achievement in both academic and most shop courses. In vocational subjects areas Mechanical Reasoning, Space Relations, and Abstract Reasoning indicated some promise as useful predictors.

The predictive value of the Kuder Preference Record: Vocational was "inconsistently" supported. The relative predictive qualities reported for a given subtest tends to vary from study to study, even though the criterion appeared to be a common subject area. The literature reviewed indicated that normally the use of the Kuder for predictive

purposes was unorthodox, and its value was in "guidance." Getzels and Jackson aptly express a conclusion of this investigation:

> Nearly everyone argues that his Kuder data might be wisely used for guidance purposes, but no one gives any reason for the nature of his particular findings, or any reason why his findings are different from those of others.[52]

For all of the three batteries of variables, little evidence could be found to support conclusions of predictive validity relating to occupational success. In fact, none of the studies encountered attempted to relate to this criterion with any adequate measure of occupational achievement.

All studies reviewed supported directly or by inference the use of multiple predictors. In studies which reported both zero order and multiple correlations, an increase in predictive power was observed from the weighted combinations of variables. Several of the studies, which reported intercorrelations both within and between the selected predictor batteries, suggest that useful prediction will likely be maximized through use of five to eight variables, of those having higher relationships to the criterion yet having the lowest relationships to each other. In general, the relative differences in the magnitude of the relationships reported between a given variable and the different achievement criteria, supports the development of differential regression equations for each subject area.

The overall conclusion, derived from the review of literature and research, is support for the reasonableness of the assumed "research

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[52] J. W. Getzels and P. W. Jackson, "The Teacher's Personality and Characteristics," Handbook of Research on Teaching (Chicago: Rand McNally), p. 528.

hypothesis" and the statistical design of this present investigation.

CHAPTER IV

THE RESEARCH DESIGN

The primary purpose of the statistical treatment in this study was to determine whether there existed significant relationships between the selected measures of student aptitude and achievement in the Vocational 22 courses. A secondary concern was to develop multiple regression equations which would provide the best possible estimate of a student's future vocational achievement.

The Null Hypothesis

The null hypothesis which was tested stated: Achievement in the Vocational 22 courses is not related to dimensions of student aptitude, as measured by the twenty-seven scores obtained from: (1) the Alberta Grade IX Record, (2) the Differential Aptitude Test Battery, and (3) the Kuder Preference Record-Vocational.

The Sample Investigated

The sample consisted of all students who completed one of the specified Vocational 22 courses in June 1964, 1965, or 1966 at Victoria Composite High School and for whom a complete set of aptitude scores was available. Table IV shows the distribution of the sample by Vocational 22 course and indicates the additional students who were rejected from the sample because of incomplete data.

TABLE IV

THE DISTRIBUTION OF THE SAMPLE BY VOCATIONAL 22 COURSE WITH THE NUMBER OF REJECTED STUDENTS INDICATED

Vocational Courses	Number of Students		
	Completed Vocational 22 Course 1964-65-66	Lacked Complete Aptitude Data	Included in Research Sample
Automotives 22	108	14	94
Beauty Culture 22	52	13	39
Commercial Art 22	104	19	85
Commercial Food 22	80	19	61
Drafting 22	91	16	75
Electricity 22	94	21	73
Electronics 22	100	14	86
Graphic Arts 22	46	6	40
Machine Shop 22	77	16	61
Performing Arts 22	35	3	32
TOTAL STUDENTS	787	141	646

The students excluded from the sample because of incomplete aptitude data were of three categories:

1. Individuals lacking an Alberta Grade IX Record, who had received a special "equivalent standing" from the Department of Education, because of attending schools outside of the Province of Alberta or because of other special circumstances.
2. Individuals lacking the Differential Aptitude Test and/or the Kuder-Vocational because they missed both the spring and fall testing period through illness or other prolonged absence, or because they transferred from other schools during the school year.
3. Individuals who, through carelessness or willfulness, rendered either standardized test invalid. For example, three students exceeded the maximum Kuder "V" score of 44 by punching all choices.

The Preparation of Data

The student aptitudes. The measures of student aptitude were obtained in the following manner:

1. The Alberta Grade IX Record in literature, language, social studies, mathematics, science, and the verbal and quantitative scores from the Cooperative School and College Aptitude Test: Level 3 were obtained in stanine form, from official Department of Education records.
2. The Differential Aptitude Test Battery (Form L) and the Kuder Preference Record-Vocational (Form C) were administered to

all vocational students at the Grade X or early Grade XI level and the resultant raw scores for each subtest obtained. In all cases the tests were scored and then rechecked by experienced professional persons to avoid possible error.

The vocational achievements. The student's vocational achievement score was the final mark in one of the Vocational Education 22 courses and was obtained, in percentage form, from the school's records as submitted to the Department of Education.

The Treatment of Data[1]

The data derived from the vocational students in the sample were placed on IBM punch cards. From these cards a "print-out" was obtained and all data rechecked by an independent observer against the original source documents. The data were then analyzed, using a "Stepwise Multiple Regression Program" on the IBM 7040 computer at the Department of Computing Science, University of Alberta.[2]

Specifically, the computer output produced for each of the ten vocational 22 courses:

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[1]The statistical procedures used throughout this study were primarily derived from: George A. Ferguson, Statistical Analysis in Psychology and Education (Toronto: McGraw-Hill Book Company, 1959); B. J. Winer, Statistical Principles in Experimental Design (Toronto: McGraw-Hill Company, 1962), pp. 1-43 and 140-224 et passim; and N. L. Gage (ed.), Handbook of Research on Teaching (Chicago: Rand McNally and Company, 1963), pp. 142-246.

[2]The structure of this program is outlined in: "Multiple Regression Program REG (G2010)" (Edmonton: Division of Educational Research Services, University of Alberta). (Mimeographed.)

1. The means, variances, and standard deviations for each of the twenty-eight separate variables of students' aptitude and achievement.
2. Zero order correlation coefficients, in the form of an inter-correlation matrix, to provide the degree of relationship between each of the twenty-eight separate variables of students' aptitude and achievement.
3. "Sets" of multiple regression analyses for the best 1, 2, 3, 4, . . .27 predictor variables, with relative regression constants, Score weights, analysis of variance, and appropriate "t" and "F" ratios. The percentage of criterion variance accounted for (R^2 x 100) provides a variance interpretation of the degree of relationship between the weighted combinations of variables of aptitude and the students' achievement.

In order to determine which of the measured dimensions of student aptitude had predictive validity, it was necessary to reject the null hypothesis. Tests were applied to determine that the aptitude-achievement correlation coefficients were significantly different from zero, by the t ratio for zero-order correlation, and by the F ratio for multiple correlation. It was assumed that if no relationship existed between the students' aptitude and the students' achievement, the expected value of the correlation coefficients would be zero. One additional test was applied at each "step" of the stepwise regression analysis. The contribution of the last added predictor variable to the regression equation was tested for significance by means of an F ratio. Rejection of the

null hypothesis, at the .05 level of confidence was taken to indicate a significant aptitude-achievement relationship. It was assumed that upon the rejection of the null hypothesis, multiple prediction equations could be developed which combined the weighted contribution of the predictively significant dimensions of student aptitude. The purpose would be to provide the "best" possible estimate of a student's potential achievement for each of the different Vocational 22 courses.

CHAPTER V

THE STATISTICAL ANALYSIS

The statistical analysis of each of the Vocational 22 groups, presented on the following pages and in the Appendix, represents a summary of the pertinent results. The final section of this chapter presents the interpretation and discussion of the statistical analysis necessary to test the "null hypothesis" and to draw conclusions on the relative value of the selected variables of student aptitude for estimating future achievement on the Vocational 22 courses considered.

The means, standard deviations, and a complete intercorrelation matrix for the twenty-eight variables of each of the ten Vocational 22 groups is presented in Tables XVI through XXVI of the Appendix.[1]

The zero-order correlation coefficients of the twenty-seven variables of student aptitude with the ten achievement criterion are reported in Table V. In examining Table V, it will be noted that the significant predictive variables are differentiated with an asterisk and the best predictor from each of the three batteries is indicated by underlining.

Tables VI through XV, together with the accompanying text, report the results of the step-wise regression analysis and analysis of variance associated with determining the most efficient combinations of significant predictors of student achievement.

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[1] Infra, pp. 107-116.

TABLE V.

ZERO ORDER CORRELATION COEFFICIENTS OF TWENTY-SEVEN VARIABLES OF APTITUDE WITH THE TEN ACHIEVEMENT CRITERION

APTITUDE VARIABLES	CRITERION OF ACHIEVEMENT									
	Automotives	Beauty Cult.	Comm. Art.	Comm. Food	Drafting	Electricity	Electronics	Graphic Arts	Machine Shop	Perf. Arts
	N=94	N=39	N=85	N=61	N=75	N=73	N=86	N=40	N=61	N=32
Agg. Stanine	.244*	.284	.278*	.357*	.099	.315*	.579*	.517*	.279*	.292
Reading Test	.233*	.039	-.016	.270*	-.192	.156	.242*	.516*	.155	.140
Literature	.121	.130	.050	.180	-.047	.089	.321*	.500*	.200	.388*
Language	-.023	.130	.171	.240	-.028	.192	.466*	.385*	.244	.191
Social Studies	.282*	.292	.267*	.312*	-.037	.276*	.459*	.376*	.244	.191
Mathematics	.232*	.435*	.347*	.197	.240*	.289*	.469*	.379*	.254*	.111
Science	.245*	.497*	.435*	.396*	.331*	.305*	.634*	.404*	.272*	.264
Verbal SCAT	.231*	.005	-.054	.189	-.065	.221	.260*	.226	-.042	.230
Quant. SCAT	.104	.230	.278*	.159	.048	.238*	.388*	.345*	.087	.184
Verb. Reas.	.204*	.108	.256*	.270*	.021	.188	.373*	.450*	.155	.083
Num. Abil.	.174	.266	.355*	.227	.308*	.295*	.271*	-.021	.206	.135
Abst. Reas.	.035	.275	.321*	-.004	.271*	.282*	.415*	.064	.181	.271
Space Rela.	.391*	.117	.429*	.066	.148	.432*	.237*	.284	.181	-.024
Mech. Reas.	.357*	.065	.279*	.068	.085	.360*	.322*	.001	.224	.025
Clerical S&A	.288*	.089	.177	.037	.394*	.149	.027	.239	-.007	.015
LU-I: Spell.	.168	-.366*	-.063	.180	-.026	.132	.211	.410*	-.030	.209
LU-II: Gram.	.246*	.125	.192	.200	-.052	.194	.299*	.493*	.167	.203
Outdoor	-.036	-.167	.138	.153	.257*	-.003	-.092	.267	-.011	-.202
Mechanical	.130	.044	.144	-.113	.213	-.126	-.141	-.185	.165	-.090
Computational	-.080	-.115	-.009	-.056	.173	.130	.339*	-.216	-.075	-.319
Scientific	-.015	-.059	.199	-.087	.135	.150	.260*	-.042	.046	-.069
Persuasive	-.010	.057	-.063	-.113	-.337*	-.342*	-.253*	-.111	-.193	.057
Artistic	.128	.235	.323*	-.241	.097	-.125	.140	.165	-.033	-.051
Literary	.131	-.221	-.116	-.114	-.324*	.130	-.001	-.066	-.128	.044
Musical	-.168	.038	-.101	-.032	-.058	.040	.075	-.059	.042	-.009
Soc. Service	-.074	-.182	-.073	.299*	-.016	.060	-.130	.168	.084	.176
Clerical	-.159	-.018	-.263*	-.023	.014	.009	.223*	-.062	-.054	-.140

Note:
1. The underlined are the most efficient single predictors from each battery.
2. * Significant at the .01 or .05 level of confidence.

TABLE VI

REGRESSION ANALYSIS AND ANALYSIS OF CRITERION VARIANCE ASSOCIATED WITH THE SEVEN MOST EFFICIENT PREDICTORS OF AUTOMOTIVES 22 ACHIEVEMENT (N = 94)

Variables Included	Zero Order r	Score Weight	Per Cent of Accounted Variance	Constant Multiple "R" Standard Error
Space Relations	.391	0.347	15.27[a]	
Social Studies	.282	3.088	4.54[a]	C = 19.34
Abstract Reasoning	.035	-0.581	5.46[a]	
Mechanical Reasoning	.357	0.377	4.12[a]	R = .605
Language	-.023	-1.888	2.35[b]	
LU-II: Gram.	.246	0.366	2.36[a]	S.E. = 9.72
Artistic	.128	0.250	2.48[a]	
PER CENT OF VARIANCE			36.58[a]	

[a]Significant at the .01 level. [b]Significant at the .05 level.

Automotives 22 (Table VI). The most efficient single predictor of achievement in Automotives 22 course, was the score of the Space Relations subtest, which accounted for 15.27 per cent of the criterion variance. The weighted sum of the scores from the Space Relations, Social Studies IX, Abstract Reasoning, Mechanical Reasoning, Language IX, Grammar, and Artistic subtests provided the best significant combination of the predictor variables, accounting for 36.58 per cent of the total criterion variance.

The multiple correlation coefficient between the weighted combination of these predictors and the criterion is R = .605, significant at the .01 level. The regression constant is 19.34 and the standard error of the criterion variable 9.72. It will be noted from an examination of

the Score weights, that Abstract Reasoning and Language IX contributed negatively within the regression equation.

TABLE VII

REGRESSION ANALYSIS AND ANALYSIS OF CRITERION VARIANCE ASSOCIATED WITH THE SEVEN MOST EFFICIENT PREDICTORS OF BEAUTY CULTURE 22 ACHIEVEMENT (N = 39)

Variables Included	Zero Order r	Score Weight	Per Cent of Accounted Variance	Constant Multiple "R" Standard Error
Science	.497	7.422	24.72[a]	
LU-I Spelling	-.366	-0.607	18.94[a]	C = 85.06
Abstract Reasoning	.275	0.298	5.21[b]	
Computations	-.114	-0.700	4.46[b]	R = .831
Verbal SCAT	.005	-4.097	9.05[a]	
Space Relations	.117	0.374	2.84[b]	S.E. = 7.91
Clerical S&A	.089	0.214	3.86[a]	
PER CENT OF VARIANCE			69.07[a]	

[a]Significant at the .01 level. [b]Significant at the .05 level.

Beauty Culture 22 (Table VII). The most efficient single predictor of achievement in the Beauty Culture 22 course was the score of the Science IX subtest, which accounted for 24.72 per cent of the criterion variance. The weighted sum of the scores from the Science IX, Spelling, Abstract Reasoning, Computational, Verbal SCAT, Space Relations, and Clerical Speed and Accuracy subtests, provided the best significant combination of the predictor variables, accounting for 69.07 per cent of the total criterion variance.

The multiple correlation coefficient between the weighted combination of these predictors and the criterion is R = .831, significant at

the .01 level. The regression constant is 85.06 and the standard error of the criterion variable 7.91. It will be noted from an examination of the Score weights, that Spelling, Computation, and Verbal SCAT contributed negatively within the regression equation. Because of the low number of students in this group (N = 39), some caution must be exercised when drawing conclusions from these results.

TABLE VIII

REGRESSION ANALYSIS AND ANALYSIS OF CRITERION VARIANCE ASSOCIATED WITH THE SIX MOST EFFICIENT PREDICTORS OF COMMERCIAL ART 22 ACHIEVEMENT (N = 85)

Variables Included	Zero Order r	Score Weight	Per Cent of Accounted Variance	Constant Multiple "R" Standard Error
Science	.435	2.832	18.90[a]	C = 21.71
Artistic	.323	0.582	6.02[a]	
Verbal SCAT	-.054	-1.945	4.98[a]	R = .631
Scientific	.199	0.280	4.04[a]	
Clerical	-.263	-0.157	3.78[a]	S.E. = 9.19
Abstract Reasoning	.321	0.245	2.11[b]	
PER CENT OF VARIANCE			39.83	

[a]Significant at the .01 level. [b]Significant at the .05 level.

Commercial Art 22 (Table VIII). The most efficient single predictor of achievement in the Commercial Art Course was the score of the Science IX subtest, which accounted for 18.90 per cent of the criterion variance. The weighted sum of the scores from the Science IX, Artistic, Verbal SCAT, Scientific, Clerical, and Abstract Reasoning subtests provided the best significant combination of the predictor variables, accounting for 39.83 per cent of the total criterion variance.

The multiple correlation coefficient between the weighted combination of these predictors and the criterion is R = .631, significant at the .01 level. The regression constant is 21.71 and the standard error of the criterion variable 9.19. It will be noted from an examination of the Score weights, that Verbal SCAT and Clerical contributed negatively within the regression equation.

TABLE IX

REGRESSION ANALYSIS AND ANALYSIS OF CRITERION VARIANCE ASSOCIATED WITH THE FIVE MOST EFFICIENT PREDICTORS OF COMMERCIAL FOOD 22 ACHIEVEMENT (N = 61)

Variables Included	Zero Order r	Score Weight	Per Cent of Accounted Variance	Constant Multiple "R" Standard Error
Science	.396	4.279	15.71[a]	C = 35.09
Soc. Service	.299	0.270	13.12[a]	
Outdoor	.153	0.302	5.99[a]	R = .670
Scientific	-.087	-0.326	5.47[a]	
Artistic	-.241	-0.226	4.54[a]	S.E. = 8.64
PER CENT OF VARIANCE			44.84[a]	

[a]Significant at the .01 level.

Commercial Foods 22 (Table IX). The most efficient single predictor of achievement in the Commercial Foods 22 course was the score of the Science IX subtest, which accounted for 15.71 per cent of the criterion variance. The weighted sum of the scores from the Science IX, Social Service, Outdoor, Scientific, and Artistic subtests provided the best significant combination of the predictor variables, accounting for 44.84 per cent of the total criterion variance.

The multiple correlation coefficient between the weighted combination of these predictors and the criterion is R = .670, significant at the .01 level. The regression constant is 35.09 and the standard error of the criterion variable 8.64. It will be noted from an examination of the Score weights, that Scientific and Artistic contributed negatively within the regression equation.

TABLE X

REGRESSION ANALYSIS AND ANALYSIS OF CRITERION VARIANCE ASSOCIATED WITH THE FIVE MOST EFFICIENT PREDICTORS OF DRAFTING 22 ACHIEVEMENT (N = 75)

Variables Included	Zero Order r	Score Weight	Per Cent of Accounted Variance	Constant Multiple "R" Standard Error
Clerical S & A	.394	0.391	15.49[a]	C = 27.63
Science	.331	4.310	13.17[a]	
Persuasive	-.337	-0.314	6.79[a]	R = .643
Literature	-.047	-2.343	5.12[a]	
Clerical	.014	0.148	2.05[a]	S.E. = 8.80
PER CENT OF VARIANCE			42.61[a]	

[a]Significant at the .01 level.

Drafting 22 (Table X). The most efficient single predictor of achievement in the Drafting 22 course was the score of the Clerical S&A subtest, which accounted for 15.49 per cent of the criterion variance. The weighted sum of the scores from the Clerical S&A, Science, Persuasive, Literature, and Clerical subtests provided the best significant combination of the predictor variables, accounting for 42.61 per cent of the total criterion variance.

The multiple correlation coefficient between the weighted combination of these predictors and the criterion is R = .653, significant at the .01 level. The regression constant is 27.63 and the standard error of the criterion variable 8.80. It will be noted from an examination of the Score weights, that Persuasive and Literature contributed negatively within the regression equation.

TABLE XI

REGRESSION ANALYSIS AND ANALYSIS OF CRITERION VARIANCE ASSOCIATED WITH THE FIVE MOST EFFICIENT PREDICTORS OF ELECTRICITY 22 ACHIEVEMENT (N = 73)

Variables Included	Zero Order r	Score Weight	Per Cent of Accounted Variance	Constant Multiple "R" Standard Error
Space Relations	.432	0.418	18.63[a]	C = 39.62
Persuasive	-.342	-0.484	6.92[a]	
Mechanical	-.126	-0.452	7.90[a]	R = .656
Social Studies	.276	2.366	5.83[a]	
Mechanical Reasoning	.360	0.492	3.79[a]	S.E. = 10.50
PER CENT OF VARIANCE			43.07[a]	

[a]Significant at the .01 level.

Electricity 22 (Table XI). The most efficient single predictor of achievement in the Electricity 22 course was the score of the Space Relations subtest, which accounted for 18.63 per cent of the criterion variance. The weighted sum of the scores from the Space Relations, Persuasive, Mechanical, Social Studies IX, and Mechanical Reasoning subtests provided the best significant combination of the predictor variables, accounting for 43.07 per cent of the criterion variance.

The multiple correlation coefficient between the weighted combination of those predictors and the criterion is R = .656, significant at the .01 level. The regression constant is C = 39.62 and the standard error of the criterion variable 10.50. It will be noted from an examination of the Score weights, that Persuasive and Mechanical contributed negatively within the regression equation.

TABLE XII

REGRESSION ANALYSIS AND ANALYSIS OF CRITERION VARIANCE ASSOCIATED WITH THE FOUR MOST EFFICIENT PREDICTORS OF ELECTRONICS 22 ACHIEVEMENT (N = 86)

Variables Included	Zero Order r	Score Weight	Per Cent of Accounted Variance	Constant Multiple "R" Standard Error
Science	.634	7.725	40.23[a]	C = -23.44
Computational	.339	0.537	5.99[a]	
Verbal Reasoning	.373	0.767	4.39[a]	R = .728
Verbal SCAT	.260	-2.212	2.38[a]	
				S.E. = 11.77
PER CENT OF VARIANCE			52.99[a]	

[a]Significant at the .01 level.

Electronics 22 (Table XII). The most efficient single predictor of achievement in the Electronics 22 course was the score of the Science IX subtest, which accounted for 40.23 per cent of the criterion variance. The weighted sum of the scores from the Science IX, Computational, Verbal Reasoning, and Verbal SCAT subtests provided the best significant combination of the predictor variables, accounting for 52.99 per cent of the total criterion variance.

The multiple correlation coefficient between the weighted combination of these predictors and the criterion is R = .728, significant at the .01 level. The regression constant is C = -23.44 and the standard error of the criterion variable 11.77. It will be noted from an examination of the Score weights, that Verbal SCAT contributed negatively within the regression equation.

TABLE XIII

REGRESSION ANALYSIS AND ANALYSIS OF CRITERION VARIANCE ASSOCIATED WITH THE SIX MOST EFFICIENT PREDICTORS OF GRAPHIC ARTS 22 ACHIEVEMENT (N = 40)

Variables Included	Zero Order r	Score Weight	Per Cent of Accounted Variance	Constant Multiple "R" Standard Error
Aggregate Stanine	.517	3.047	26.77[a]	C = -2.45
Verbal Reasoning	.450	0.564	10.98[a]	
Clerical S&A	.239	0.429	9.32[a]	R = .775
Artistic	.165	0.278	4.60[b]	
Verbal SCAT	.226	-2.588	3.78[b]	S.E. = 7.56
Literature	.500	2.294	4.59[a]	
PER CENT OF VARIANCE			60.04[a]	

[a]Significant at the .01 level. [b]Significant at the .05 level.

Graphic Arts 22 (N = 40). The most efficient single predictor of achievement in the Graphic Arts 22 course was the score of the Aggregate Stanine, which accounted for 26.77 per cent of the criterion variance. The weighted sum of the scores from the Aggregate Stanine, Verbal Reasoning, Clerical S&A, Artistic, Verbal SCAT, and Literature IX subtests provided the best significant combination of the predictor variables,

accounting for 60.04 per cent of the total criterion variance.

The multiple correlation coefficient between the weighted combination of these predictors and the criterion is R = .775, significant at the .01 level. The regression constant is -2.45, and the standard error of the criterion variable 7.56. It will be noted from an examination of the Score weights, that Verbal SCAT contributed negatively within the regression equation. Because of the low number of students in this group (N = 40) some caution must be exercised when drawing conclusions from these results.

Machine Shop 22 (Table XIV). The most efficient single predictor of achievement in the Machine Shop 22 course was the score of the Aggregate Stanine, which accounted for 7.81 per cent of the criterion variance. The weighted sum of the scores from the Aggregate Stanine, Verbal SCAT, Space Relations, Persuasive, Language IX, and Social Studies IX subtests provided the best significant combination of the predictor variables, accounting for 29.19 per cent of the total criterion variance.

The multiple correlation coefficient between the weighted combination of these predictors and the criterion is R = .541, significant at the .01 level. The regression constant is C = 42.33 and the standard error of the criterion variable 11.83. It will be noted from an examination of the Score weights, that Verbal SCAT and Persuasive contributed negatively within the regression equation. It will be noted that the variable "Persuasive" entered the regression equation at a level of confidence of .10.

TABLE XIV

REGRESSION ANALYSIS AND ANALYSIS OF CRITERION VARIANCE ASSOCIATED WITH THE SIX MOST EFFICIENT PREDICTORS OF MACHINE SHOP 22 ACHIEVEMENT (N = 61)

Variables Included	Zero Order r	Score Weight	Per Cent of Accounted Variance	Constant Multiple "R" Standard Error
Aggregate Stanine	.279	0.208	7.81[b]	C = 42.33
Verbal SCAT	-.042	-3.271	4.96[b]	
Space Relations	.181	0.491	5.70[b]	R = .541
Persuasive	-.193	-0.252	3.24[c]	
Language	.244	3.125	3.30[b]	S.E. = 11.83
Social Studies	.244	3.056	4.19[a]	
PER CENT OF VARIANCE			29.19[a]	

[a]Significant at the .01 level. [b]Significant at the .05 level.

[c]Significant at the .10 level.

Performing Arts 22 (N = 32). The most efficient single predictor of achievement in the Performing Arts 22 course was the score of the Literature IX subtest, which accounted for 15.06 per cent of the criterion variance. The weighted sum of the scores from the Literature IX, Computational, Abstract Reasoning, and Verbal Reasoning subtests provided the best significant combination of the predictor variables, accounting for 38.86 per cent of the total criterion variance.

The multiple correlation coefficient between the weighted combination of these predictors and the criterion is R = .623, significant at the .01 level. The regression constant is 49.29 and the standard error of the criterion variable 5.40. It will be noted from an examination of the Score weights, that Computational and Verbal Reasoning contributed

TABLE XV

REGRESSION ANALYSIS AND ANALYSIS OF CRITERION VARIANCE ASSOCIATED WITH THE FOUR MOST EFFICIENT PREDICTORS OF PERFORMING ARTS 22 ACHIEVEMENT (N = 32)

Variables Included	Zero Order r	Score Weight	Per Cent of Accounted Variance	Constant Multiple "R" Standard Error
Literature	.388	1.734	15.06[b]	C = 49.29
Computational	-.319	-0.350	7.08[c]	R = .623
Abstract Reasoning	.271	0.591	10.73[b]	S.E. = 5.40
Verbal Reasoning	.083	-0.267	5.99[c]	
PER CENT OF VARIANCE			38.86[a]	

[a]Significant at the .01 level. [b]Significant at the .05 level.

[c]Significant at the .10 level.

negatively within the regression equation. Because of the low number of students (N = 32) extreme caution must be exercised when drawing conclusions from these results. Computational and Verbal Reasoning entered the regression equation at .10 level of confidence.

Observations and Conclusions Respecting Data Analysis

The zero order correlation coefficients for the best single predictor of achievement of the twenty-seven variables for each Vocational 22 groups ranged from .279 to .634. All were significant at the .01 level of confidence.[2]

It will be noted that in the case of Machine Shop and Performing

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[2]Supra, Table V, p. 77.

Arts none of the zero order coefficients from the Differential Aptitude Test were significant at the .05 level. In the case of Machine Shop, Performing Arts, Beauty Culture, and Graphic Arts none of the zero order coefficients from the Kuder-Vocational were significant at the .05 level of confidence. However, in the case of all of the Vocational 22 groups, one or more of the variables of the Grade IX Record had zero order predictive significance at the .05, or greater, level of confidence.[3]

The combinations of significant predictive variables into multiple regression equations resulted in multiple correlation coefficients ranging from .541 to .831. In the case of each Vocational 22 group the use of a combination of weighted variables resulted in a significant improvement over the best single predictor in the amount of criterion variance accounted for.

A comparison of the regression equations associated with each of the Vocational 22 courses indicates that:

1. Science IX was the most useful predictor of the three batteries. Science IX was the best predictor for Beauty Culture 22, Commercial Art 22, Commercial Food 22, and Electronics 22. It was second best in Drafting 22.
2. Space Relations subtest of DAT was the best predictor for Automotives 22 and Electricity 22.
3. Aggregate Stanine IX was the best predictor for Graphic Arts 22 and Machine Shop 22.

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[3] Ibid.

4. Clerical Speed and Accuracy (DAT) and Literature IX were the best predictors of Drafting 22 and Performing Arts 22, respectively.

5. Reading Test IX, Mathematics IX, Quantitative SCAT, Numerical Ability (DAT), Literary (KPR-V), and Musical (KPR-V) did not significantly contribute to any of the multiple regression equations.

On the basis of the statistical results the null hypothesis was rejected. For all of the Vocational 22 group, the significance of the observed correlation coefficients, resulting from the optimum multiple regression equation, permitted rejection of the null hypothesis at the .01 level of confidence. Similarly, the analysis of variance, which established the significance of the contribution of each added predictor, supports the rejection of the null hypothesis at the .01 or .05 level of confidence, with two exceptions. These exceptions are Machine Shop 22, where one variable; and Performing Arts, where two variables, entered the regression equation at a level of .10.

Multiple prediction equations for each Vocational 22 course can be derived from the results reported in Tables VI through XIV.[4] The equation is:

$$Y = C + W_1X_1 + W_2X_2 \ldots + W_nX_n.$$

Where: Y is the best estimate of future achievement; C is the regression constant; W is the Score weight associated with a predictor variable and

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[4] Supra, pp. 78 et seqq.

X is the student's score in that variable. For example, the best estimate of Electronics 22 achievement is given by:

$$\text{Predicted Electronics 22 Mark} = -23.44 + 7.73\,(\text{Science IX}) + .54\,(\text{Computational}) + .77\,(\text{Verb. Reas.}) + -2.21\left[(\text{Verbal SCAT})\right].$$

The standard error of estimate of the "predicted Electronics 22 mark" is 11.77. Similarly, prediction equations could be developed for each of the other Vocational 22 courses.

CHAPTER VI

SUMMARY AND CONCLUSIONS

The general concern of this study was to identify and describe those student aptitudes that are associated with successful achievements in the vocational programs of the Alberta High School System. The specific purpose of the statistical treatment was to determine whether there existed significant relationships between the selected predictors and future achievement in the Vocational 22 courses of one Composite High School. A secondary concern was to develop multiple regression equations, which would provide the best possible estimate of a student's future vocational achievement, as a basis for developing effective student allocation procedures.

The Vocational 12, 22, and 32 course sequences were the differentiating feature between the alternative vocational programs. They are intended to provide a basic preparation and, as far as is possible, the specialized behaviour necessary for entry, advancement, and additional training in specific occupational areas.

Vocational achievement is evaluated in terms of the demonstrated behaviour relative to "typically competent" persons in a given occupational area. For the purposes of this research investigation, student achievement was quantitatively described by the final marks received in the selected Vocational 22 courses.

Student aptitude was defined, for this study, as the potential

for successful achievement in an instructional program. The selected measures used for evidence of student aptitude were: the Alberta Grade IX Record; (2) the Differential Aptitude Test Battery; and (3) the Kuder Preference Record-Vocational. As a result of the review of literature and research, these measures were described and supporting evidence of their predictive value established for related academic and nonacademic educational settings, which were pertinent to the vocational programs and courses considered.

A number of conclusions were drawn from the review of research and expert opinion. Some generalized conclusions are as follows:

1. Courses which appear to require higher levels of verbal and quantitative abilities for successful achievement reflect greater relationships to corresponding predictor variables of the Grade IX Record and the DAT. At the high school level, and to a lesser extent at the University, the Grade IX Record provides the best predictor battery for a wide range of academic and elective courses.
2. Courses which appear to require higher levels of non-verbal and non-quantitative abilities, including physical skills and creative talents, are less predictable with verbal and quantitative factors of aptitude. For these courses Science IX, and Mechanical Reasoning, Space Relations, and Abstract Reasoning of the DAT, hold the best promise of general predictive validity.
3. The use of the Kuder for predictive purposes finds only

inconsistent support. This, in part, may be from lack of reliable criterion measures which are comparable between studies.

Design of the Study

The Null Hypothesis tested stated: Achievement in the selected Vocational 22 courses is not related to dimensions of student aptitude as measured by the twenty-seven scores obtained from: (1) the Alberta Grade IX Record, (2) the Differential Aptitude Test Battery, and (3) the Kuder Preference Record-Vocational.

The sample, totaling 646 subjects, consisted of the students who completed the Vocational 22 courses in June, 1964, 1965, or 1966 at one Composite High School. Students without complete aptitude data were not included in the research sample. The criterion of achievement was the final mark received in the vocational education courses, Automotives 22, Beauty Culture 22, Commercial Art 22, Commercial Foods 22, Drafting 22, Electricity 22, Electronics 22, Graphic Arts 22, Machine Shop 22, and Performing Arts 22. The predictor variables were the twenty-seven separate scores obtained from the assumed measures of student aptitude.

The "Step-Wise Multiple Regression Analysis Program" was used to determine, for the combined batteries, the significant predictive relationships and to arrange the weighted relationships in descending order, from the most efficient predictors to the least, to account for all possible significant criterion variance. All data was processed under the direction of the Division of Educational Research Services, at the Department of Computing Science, University of Alberta.

Conclusions

Several pertinent conclusions were drawn as the result of the statistical analysis. These were:

1. All of the selected predictive variables, with the exceptions of Kuder Mechanical and Kuder Musical subtests, indicated a significant relationship to achievement in at least one or more of the Vocational 22 courses. The null hypothesis was therefore rejected.
2. There exists a high degree of inter-correlation between certain of the predictors. When used in weighted combination, between four and seven of the predictive variables are able to account for the maximum possible criterion variance, which ranges from 29.19 per cent to 69.07 per cent.
3. The weighted combination of aptitude variables within a regression equation results in improving the predictive relationship, over using any of the significant single predictors of achievement.
4. The most useful predictors of Vocational 22 course achievement, in descending value, were: Science IX, Space Relations, Aggregate Stanine, Clerical Speed and Accuracy, and Literature IX. However, it was noted that at least one variable from each of the three predictive batteries occurred in the optimum regression equation associated with each of the Vocational 22 courses.
5. The observed differentiation in the relative contribution, of the twenty-seven variables to the prediction equations

associated with each Vocational 22 course, warrants further consideration. For example, the development of discriminant scores and sets of profiles may well prove of value as an aid to the allocation of students within the alternative vocational programs.

Some Final Observations

Generalizations or the transfer of conclusions from this investigation to other contexts must be made with extreme caution. However, several implications for present practice and future research are inherent in the findings.

The present practice of using only academic course achievements as allocation criteria or basic guidance data for vocational programs warrants revision. For example, a mathematics prerequisite which is generally applied, regardless of program, to screen potential vocational students must be questioned. Also, the general use of the Kuder-Vocational for "guidance" purposes needs re-examination. Are the Kuder's predictive qualities as inconsistent as reported in the other studies reviewed, or as often inversely correlated to certain vocational achievements as this statistical treatment would indicate? If so, then its continued use requires a "probability" interpretation along with the "interest" interpretation now provided on the student "Profile Sheet."

There is need for predictive studies using larger samples from a number of different schools in both urban and rural Alberta. In addition to further testing of the variables used in this present study, other batteries such as the Strong Vocational Interest Blank, the

Flanagan Aptitude Classification Test, or the Study of Values might be considered. In particular, valid predictors of the capacity to acquire the physical skills and creative talents of the various technical, trade, and service occupations are required. Follow-up studies of the relationship predictors to later occupational success must be undertaken. For example, with the wealth of accumulated data available, the relationship of the Grade IX Record to success in the twenty-four designated trade areas might be undertaken, particularly when criterion ratings for "apprentices" are currently available.

Other statistical treatments might be tried, such as the use of the discriminant function or the canonical correlation or factor analysis. For example, using predictive data similar to the present study, but simultaneously considering the concurrent inter-relationship of both academic and vocational course achievement through use of canonical correlation techniques, the unaccountable criterion variation encountered in studies with no covariance control might be contained. Factorial studies could be designed to quantitatively describe the differentiation of performances and expectations required for successful achievement, between different subject areas. This might permit a comparison of the relative verbal and quantitative factors or the cognitive, creative, and physical factors inherent in success in the different course sequences. The ability to isolate and quantify these factors of achievement for different subjects, on a common scale, might allow research knowledge of valid predictors to be applied through appropriate transformations to all subject areas.

The urgency of the need for further study and research in the area of student allocation criteria is aptly stated in a quotation attributed to John C. Flanagan:

> . . .The national waste (abuse and misuse) of human resources is appalling. Anyone assigning a dollar value to the squander of human talents will be wide of the mark and there is no way to begin to estimate the additional cost in frustration and unhappiness for the individual whose time and effort go into activities which bring them little satisfaction.

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APPENDIX

TABLES XVI TO XXV

TABLE XX

MEANS, STANDARD DEVIATIONS, AND INTERCORRELATIONS
FOR TWENTY-EIGHT VARIABLES OF THE DRAFTING "22" GROUP (N=75)

PREDICTORS			GRADE IX RECORD									DIFFERENTIAL APTITUDE								KUDER-VOCATIONAL									
	MEAN	SD	Agg. St.	Read.	Lit.	Lang.	Soc. S.	Math.	Science	Verb.	Quant.	Verb. R.	Num. A.	Abst. R.	Space R.	Mech. R.	Cl. S&A	Spell	Gram.	Outd.	Mech.	Comp.	Sci.	Pers.	Art.	Lit.	Mus.	S. Serv.	Cler.
Agg. Stanine	4.87	1.09																											
Reading Test	4.64	1.49	458																										
Literature	4.51	1.37	686	394																									
Language	4.27	1.46	600	213	454																								
Social Studies	5.12	1.38	738	317	577	423																							
Mathematics	5.09	1.42	688	054	317	375	307																						
Science	5.43	1.39	768	212	539	325	518	599																					
Verbal SCAT	5.00	1.49	522	662	378	299	482	186	288																				
Quant. SCAT	5.11	1.40	494	270	324	384	260	554	331	311																			
Verb. Reas.	32.80	6.77	463	520	365	347	315	342	357	574	447																		
Num. Abil	32.40	4.73	261	-044	108	238	130	418	258	-010	408	241																	
Abst. Reas.	39.08	4.69	342	176	084	248	198	288	415	279	246	360	293																
Space Rela.	45.84	7.83	154	072	-097	032	086	174	255	128	175	202	278	382															
Mech. Reas.	55.87	5.96	146	149	-023	-004	027	192	260	279	230	207	003	079	409														
Clerical S&A	56.16	10.05	-122	-398	-147	-148	-102	091	-079	-302	054	-133	259	186	120	-112													
LU-I: Spell.	73.81	12.34	060	075	006	184	042	-050	-036	213	082	014	-148	-128	-059	-055	-044												
LU-II: Gram.	31.71	7.72	392	251	229	402	347	219	336	444	317	576	175	225	112	273	-177	300											
Outdoor	45.49	14.55	014	006	035	-019	038	057	064	117	001	113	195	109	086	-032	149	101	096										
Mechanical	45.31	8.91	-073	037	-154	-106	-250	099	137	063	013	-010	291	162	287	114	026	-013	001	183									
Computational	27.41	7.47	-096	-310	-074	047	-200	127	-043	-253	032	005	135	119	-038	-175	200	-120	-148	-152	035								
Scientific	39.29	10.79	117	-111	095	011	119	118	247	125	044	068	059	006	051	041	058	-064	-070	211	130	362							
Persuasive	37.68	10.24	089	201	-035	051	126	034	-042	075	089	098	-118	-001	065	218	-154	-109	149	-633	-205	-147	-338						
Artistic	35.60	8.40	-163	-132	-131	-109	-189	-108	-038	-189	-077	-113	001	076	009	-031	099	-139	-144	-017	-047	-208	-389	-066					
Literary	16.69	7.80	206	375	271	069	322	-019	-010	266	043	287	-285	-158	-242	-056	-219	154	113	-212	-406	-051	-064	186	-402				
Musical	11.92	7.50	166	175	179	110	093	012	103	132	059	225	-116	166	002	062	-015	-068	095	-258	-284	-306	-370	245	200	-004			
Soc. Service	31.55	12.16	-041	-178	-036	-074	020	-012	-081	-310	025	-367	031	-230	-089	-163	066	043	-136	054	-113	-157	-163	-128	-051	-003	-266		
Clerical	46.55	11.23	-117	-209	-046	102	-150	-044	-216	-149	-210	-116	-028	-088	-132	-074	-007	062	024	-246	009	385	-043	101	-103	-118	-146	-367	
CRITERION																													
Drafting	57.47	11.22	099	-192	-047	-028	-037	240	331	-065	048	021	308	271	148	085	394	-026	-052	257	213	173	135	-337	097	-324	-057	-016	014

TABLE XX1

MEANS, STANDARD DEVIATIONS, AND INTERCORRELATIONS
FOR TWENTY-EIGHT VARIABLES OF THE ELECTRICITY "22" GROUP (N = 73)

PREDICTORS			GRADE IX RECORD									DIFFERENTIAL APTITUDE								KUDER-VOCATIONAL									
	MEAN	SD	Agg. St.	Read.	Lit.	Lang.	Soc. S.	Math.	Science	Verb.	Quant.	Verb. R.	Num. A.	Abst. R.	Space R.	Mech. R.	Cl. S&A	Spell	Gram.	Outd.	Mech.	Comp.	Sci.	Pers.	Art.	Lit.	Mus.	S. Serv.	Cler.
Agg. Stanine	5.08	1.26																											
Reading Test	4.81	1.85	696																										
Literature	4.92	1.55	730	649																									
Language	4.23	1.67	739	510	623																								
Social Studies	5.26	1.29	715	417	482	532																							
Mathematics	5.19	1.21	749	421	393	445	448																						
Science	5.68	1.45	830	506	531	517	585	573																					
Verbal SCAT	5.15	1.66	736	700	686	570	404	554	523																				
Quant. SCAT	5.21	1.44	596	589	435	475	396	502	502	510																			
Verb. Reas.	33.04	7.32	654	791	613	537	374	434	515	674	570																		
Num. Abil.	32.70	4.55	527	421	242	415	262	356	538	273	496	487																	
Abst. Reas.	38.05	6.39	204	251	-022	223	128	125	114	177	293	360	413																
Space Rela.	39.14	10 .65	289	358	-000	082	043	364	291	287	461	410	372	560															
Mech. Reas.	55.93	6.09	286	288	132	090	082	254	432	296	292	344	338	361	481														
Clerical S&A	55.85	9.75	164	024	055	159	215	-001	152	017	079	-011	094	155	015	-015													
LU-1: Spell.	75.08	12.41	526	468	559	614	434	314	325	502	420	486	304	220	077	029	098												
LU-11: Gram.	31.67	7.80	573	611	542	594	262	390	387	643	375	643	411	328	255	283	-023	576											
Outdoor	49.60	14.03	059	079	021	147	126	-073	058	001	117	084	033	-019	004	070	-035	002	-068										
Mechanical	50.99	9.09	150	270	052	225	012	125	238	-008	365	263	239	168	253	172	-177	171	107	248									
Computational	28.05	7.92	-002	-135	-123	-155	028	060	073	-066	-112	-059	122	146	150	-022	048	-090	-090	-334	-184								
Scientific	47.07	8.88	264	144	110	154	203	197	367	182	035	137	114	-040	-041	077	-073	081	174	102	082	142							
Persuasive	35.95	8.59	-115	-106	-098	-080	-064	-081	-074	-041	-099	-160	-210	-133	-194	-037	065	-030	-112	-290	-179	-082	-208						
Artistic	26.67	6.82	-170	-123	-199	-185	-041	-031	-175	-130	022	-049	-057	090	-078	006	143	012	-217	054	-196	-198	-195	102					
Literary	15.49	7.22	247	150	320	180	174	075	125	313	-030	123	056	-088	-026	-041	153	237	183	-244	-309	215	003	011	-282				
Musical	10.47	7.20	-158	-100	056	-009	-230	-018	-162	-048	-108	041	-114	002	-056	087	-091	-100	185	-263	-279	-018	-220	-144	040	-046			
Soc. Service	32.66	10.74	-112	-072	-076	-146	-096	-151	-229	-129	-192	-127	-129	-092	-074	-066	056	-178	-109	124	-167	-281	-316	-001	-144	003	-049		
Clerical	46.45	10 .84	-145	-216	-191	-148	-134	-002	-076	-145	-058	-240	026	016	070	-112	-018	-071	-119	-481	-016	420	-008	030	-102	-093	-085	-412	
CRITERION																													
Electricity	55.55	13.43	315	156	089	192	276	289	305	221	238	188	295	282	432	361	149	132	194	-003	-126	130	150	-342	-125	130	040	060	009

TABLE XXII

MEANS, STANDARD DEVIATIONS, AND INTERCORRELATIONS
FOR TWENTY-EIGHT VARIABLES OF THE ELECTRONICS "22" GROUP (N = 86)

PREDICTORS	MEAN	SD	GRADE IX RECORD									DIFFERENTIAL APTITUDE								KUDER-VOCATIONAL									
			Agg. St.	Read.	Lit.	Lang.	Soc. S.	Math.	Science	Verb.	Quant.	Verb. R.	Num. A.	Abst. R.	Space R.	Mech. R.	Cl. S&A	Spell.	Gram.	Outd.	Mech.	Comp.	Sci.	Pers.	Art.	Lit.	Mus.	S. Serv.	Cler.
Agg. Stanine	5.76	1.35																											
Reading Test	5.02	1.71	648																										
Literature	5.08	1.64	719	579																									
Language	4.97	1.73	809	537	668																								
Social Studies	5.70	1.45	826	493	600	648																							
Mathematics	6.22	1.49	762	289	407	573	522																						
Science	6.51	1.31	795	421	534	584	704	605																					
Verbal SCAT	5.53	1.58	637	782	617	470	497	338	462																				
Quant. SCAT	5.85	1.55	642	361	416	427	508	711	554	444																			
Verb. Reas.	35.17	7.08	522	570	435	473	478	342	282	597	348																		
Num. Abil.	35.44	3.89	380	167	217	290	291	492	175	225	589	473																	
Abst. Reas.	40.35	4.63	430	340	195	254	302	451	335	356	564	584	526																
Space Rela.	43.50	10.26	186	221	042	141	061	287	236	270	378	294	312	552															
Mech. Reas.	58.33	6.11	270	321	145	205	111	230	405	409	207	391	136	420	573														
Clerical S & A	57.66	11.85	125	072	096	148	145	068	156	-024	176	-147	023	056	244	-093													
LU-1: Spell.	75.80	13.92	455	335	384	467	452	298	154	334	272	413	164	289	-089	-052	-045												
LU-11: Gram.	34.72	7.69	484	428	478	446	381	246	321	486	308	484	253	353	012	281	-128	475											
Outdoor	48.22	11.95	-146	-090	-035	-155	015	-222	079	-062	-143	-075	-129	-034	137	169	090	-071	003										
Mechanical	51.52	8.59	-210	-180	-039	-226	-175	-095	-057	-046	-053	-234	-290	-093	118	012	-014	-376	-233	172									
Computational	30.40	7.44	208	000	-012	149	104	278	153	-013	290	017	267	096	073	042	077	011	032	-272	-287								
Scientific	50.47	9.35	046	-026	061	-064	074	-055	203	-081	-080	-043	-098	-087	044	-006	-059	-078	052	218	-132	271							
Persuasive	34.59	10.68	-107	-036	-013	-033	-070	004	-242	021	010	-134	033	-154	-173	-305	031	-001	-143	-373	035	-295	-403						
Artistic	25.76	7.92	109	021	-001	113	073	140	113	019	144	154	089	234	308	113	140	065	-049	068	043	-136	-141	-020					
Literary	16.16	7.90	223	410	280	171	167	-044	054	360	-032	247	-022	-075	-154	050	-019	207	277	-152	-472	075	084	-031	-328				
Musical	10.12	6.92	196	219	146	295	053	065	060	203	108	284	236	118	-047	106	034	077	408	-234	-240	102	-239	-134	-094	213			
Soc. Service	30.95	10.40	-228	-257	-263	-319	-168	-156	-132	-251	-156	-139	-072	-017	-207	-136	-214	-070	-208	-006	-092	-169	-074	-165	-123	-085	-151		
Clerical	47.84	10.60	146	-052	-007	194	044	283	011	-065	198	009	082	083	042	-027	-019	199	154	-367	-060	521	-034	-003	-063	-167	029	-345	
CRITERION																													
Electronics	57.91	16.76	579	242	321	466	459	469	634	260	388	373	270	415	237	312	027	211	299	091	141	339	260	253	140	-001	075	-130	223

TABLE XXIII

MEANS, STANDARD DEVIATIONS, AND INTERCORRELATIONS
FOR TWENTY-EIGHT VARIABLES OF THE GRAPHIC ARTS "22" GROUP (N = 40)

PREDICTORS			GRADE IX RECORD									DIFFERENTIAL APTITUDE								KUDER-VOCATIONAL									
	MEAN	SD	Agg. St.	Read.	Lit.	Lang.	Soc. S.	Math.	Science	Verb.	Quant.	Verb. R.	Num. A.	Abst. R.	Space R.	Mech. R.	Cl. S&A	Spell.	Gram.	Outd.	Mech.	Comp.	Sci.	Pers.	Art.	Lit.	Mus.	S. Serv.	Cler.
Agg. Stanine	4.68	1.37																											
Reading Test	5.13	1.47	608																										
Literature	4.60	1.60	620	665																									
Language	4.15	1.61	815	522	572																								
Social Studies	5.00	1.24	711	604	543	526																							
Mathematics	4.50	1.55	780	342	300	554	413																						
Science	4.85	1.49	792	370	264	553	512	696																					
Verbal SCAT	5.10	1.45	393	621	583	467	400	-000	149																				
Quant. SCAT	4.52	1.57	548	215	423	445	290	447	494	202																			
Verb. Reas.	31.60	7.93	250	405	499	204	365	031	200	478	423																		
Num. Abil.	29.23	6.59	325	042	128	188	226	437	308	-118	537	084																	
Abst. Reas.	37.88	4.90	-022	262	295	006	-021	-106	-118	338	312	337	215																
Space Rela.	35.53	9.25	231	155	006	213	134	296	216	078	424	221	351	411															
Mech. Reas.	51.58	6.33	132	091	006	027	010	129	321	145	346	145	155	199	398														
Clerical S&A	55.53	9.73	-064	099	-182	-048	-132	-115	-051	013	-027	-108	-274	076	117	-038													
LU-I: Spell	74.05	13.60	463	593	618	550	374	264	178	511	268	282	174	300	172	090	125												
LU-II: Gram.	30.68	9.13	425	574	513	486	349	227	246	569	370	403	127	304	316	077	174	544											
Outdoor	44.85	13.43	067	216	253	095	109	-020	036	145	-193	133	-327	-011	-184	033	-025	279	021										
Mechanical	36.25	10.71	-157	-106	-135	-337	-075	011	-055	-296	-257	-307	-004	-323	-262	117	-130	-151	-494	310									
Computational	22.53	8.45	-045	-245	-341	-128	-100	108	140	-111	364	-208	360	043	216	136	134	-243	-046	-460	-128								
Scientific	34.55	9.78	081	-087	044	034	013	089	129	070	143	-082	096	-349	005	339	-079	024	071	-007	249	209							
Persuasive	45.55	10.96	019	088	-139	079	164	090	030	006	112	108	124	019	222	142	003	-016	062	-372	-040	-084	-230						
Artistic	32.58	9.95	-044	-035	-011	-089	-042	-092	-113	097	-366	-054	-410	036	-014	-279	-031	-114	016	156	-282	-224	-230	-323					
Literary	20.85	7.08	-034	061	223	-016	-222	-149	-002	264	111	026	-010	342	034	-003	-110	-008	213	-048	-121	036	-118	-353	015				
Musical	11.58	5.97	-099	-146	-115	073	-080	-137	-114	-099	-014	064	236	051	180	-209	-084	-238	098	-256	-203	047	-118	052	-108	225			
Soc. Service	35.75	12.24	131	161	142	158	-012	076	109	-074	249	240	068	173	162	203	192	260	004	-105	-150	-236	-035	283	-337	-276	-141		
Clerical	45.08	10.74	-051	-106	-166	-056	-000	070	-042	-179	121	-173	211	106	008	-170	-009	019	002	-251	-213	402	-311	-025	054	-011	-145	-380	
CRITERION																													
Graphic Arts	59.88	11.01	518	516	500	385	376	379	404	226	345	450	-021	064	284	001	239	410	493	267	-185	-216	-042	-111	165	-066	-059	168	-062

TABLE XXIV

MEANS, STANDARD DEVIATIONS, AND INTERCORRELATIONS
FOR TWENTY-EIGHT VARIABLES OF THE MACHINE SHOP "22" GROUP (N = 61)

PREDICTORS			GRADE IX RECORD									DIFFERENTIAL APTITUDE								KUDER-VOCATIONAL									
	MEAN	SD	Agg. St.	Read.	Lit.	Lang.	Soc. S.	Math.	Science	Verb.	Quant.	Verb. R.	Num. A.	Abst. R.	Space R.	Mech. R.	Cl. S&A	Spell	Gram.	Outd.	Mech.	Comp.	Sci.	Pers.	Art.	Lit.	Mus.	S. Serv.	Cler.
Agg. Stanine	4.52	1.10																											
Reading Test	4.51	1.56	473																										
Literature	3.98	1.19	742	365																									
Language	4.03	1.61	711	365	704																								
Social Studies	4.62	1.25	614	057	454	320																							
Mathematics	4.46	1.32	619	200	375	415	216																						
Science	5.25	1.07	718	363	459	399	478	376																					
Verbal SCAT	4.57	1.48	527	705	404	454	236	119	372																				
Quant. SCAT	4.72	1.39	433	405	359	286	178	550	381	176																			
Verb. Reas.	30.31	7.46	485	457	374	357	189	249	242	466	323																		
Num. Abil.	29.18	5.20	314	310	138	208	141	513	093	119	575	531																	
Abst. Reas.	36.33	6.07	153	362	-025	-016	-086	288	161	200	267	462	508																
Space Rela.	39.02	11.08	-036	314	-229	-226	-258	068	106	145	147	437	385	700															
Mech. Reas.	56.48	6.61	194	360	003	006	-087	142	338	308	277	346	152	584	566														
Clerical S&A	54.03	10.35	-099	-159	031	074	-016	-095	-050	-088	-011	062	096	125	073	040													
LU-I: Spell	72.64	12.67	315	140	378	528	077	027	156	380	069	176	038	-100	-187	-058	042												
LU-II: Gram.	29.69	7.27	347	564	356	482	053	147	264	483	271	363	302	225	205	182	-108	375											
Outdoor	52.26	13.37	-064	-010	039	-056	109	-245	-036	-084	-222	-088	-223	-099	-093	-218	-025	049	099										
Mechanical	51.25	8.62	035	-190	020	-025	-038	047	029	-068	-150	-122	-185	-068	-077	024	080	047	-022	191									
Computational	26.41	7.30	-046	-088	-047	-072	-008	123	-075	-035	205	088	302	041	083	091	076	-128	-072	-472	-171								
Scientific	43.30	9.02	-022	-149	-034	-220	157	065	108	-098	016	-092	-044	-011	-053	068	018	-163	-140	210	289	194							
Persuasive	34.85	9.88	-123	-139	-121	-098	-083	-053	-108	-071	145	-058	058	-036	076	-079	-069	-101	011	-253	-273	-130	-447						
Artistic	29.28	7.13	131	157	-031	053	087	027	135	084	-071	212	150	122	200	-079	052	012	159	156	068	-220	-126	-026					
Literary	14.75	6.58	286	372	225	320	037	067	086	382	040	193	-010	-079	-070	-024	-175	197	182	-209	-299	097	-275	-006	-049				
Musical	10.48	7.43	028	211	-010	201	-140	-126	-032	034	-079	153	011	135	125	121	013	-120	-081	-180	-297	013	-418	-056	-103	091			
Soc. Service	34.70	10.84	-009	187	100	054	035	056	045	105	233	097	098	197	013	230	262	054	083	104	-164	-170	096	-187	-204	-058	-081		
Clerical	45.30	11.25	-190	-188	-087	-083	-212	001	-269	-177	-004	-270	-007	-228	-224	-182	-147	113	-109	-392	-219	463	104	023	-421	089	-075	-340	
CRITERION																													
Machine Shop	65.41	13.33	279	155	200	244	244	254	272	-042	087	155	206	181	181	224	-007	-030	167	-011	165	-075	046	-193	-033	-128	042	084	-054

TABLE XXV

MEANS, STANDARD DEVIATIONS, AND INTERCORRELATIONS
FOR TWENTY-EIGHT VARIABLES OF THE PERFORMING ARTS "22" GROUP (N = 32)

PREDICTORS			GRADE IX RECORD									DIFFERENTIAL APTITUDE								KUDER-VOCATIONAL									
	MEAN	SD	Agg. St.	Read.	Lit.	Lang.	Soc. S.	Math.	Science	Verb.	Quant.	Verb. R.	Num. A.	Abst. R.	Space R.	Mech. R.	Cl S&A	Spell.	Gram.	Outd.	Mech.	Comp.	Sci.	Pers.	Art.	Lit.	Mus.	S. Serv.	Cler.
Agg. Stanine	5.75	1.46																											
Reading Test	6.28	1.67	625																										
Literature	6.25	1.74	762	496																									
Language	5.84	1.85	821	609	753																								
Social Studies	5.78	1.75	935	550	747	794																							
Mathematics	5.06	1.52	849	462	614	587	766																						
Science	5.66	1.60	806	388	611	581	789	632																					
Verbal SCAT	6.47	1.48	728	715	604	698	761	502	506																				
Quant. SCAT	5.09	2.05	719	491	453	505	650	834	492	526																			
Verb. Reas.	37.38	8.02	673	486	564	580	689	598	476	653	527																		
Num. Abil.	30.41	6.64	570	280	245	318	501	623	451	292	778	611																	
Abst. Reas.	38.59	5.00	282	277	127	174	320	194	256	410	503	431	582																
Space Rela.	38.47	10.97	124	061	-057	-030	069	207	074	105	329	165	416	546															
Mech. Reas.	51.16	6.91	241	046	174	216	306	278	227	308	377	331	315	485	593														
Clerical S&A	64.06	14.48	198	267	035	234	164	093	115	173	194	344	361	422	044	-156													
LU-I: Spell.	84.19	12.10	675	575	697	781	669	537	435	612	474	618	313	145	-114	-037	401												
LU-II: Gram.	41.09	7.05	535	367	410	443	554	531	398	422	483	670	586	472	125	093	497	603											
Outdoor	34.03	13.93	-309	-178	-397	-336	-244	-239	-359	-453	-052	-174	110	032	140	-061	003	-225	-091										
Mechanical	22.03	10.23	-341	-304	-450	-449	-260	-300	-139	-372	-187	-372	-178	-159	165	154	-316	-432	-301	439									
Computational	13.75	6.36	076	-127	-143	095	087	132	029	064	239	134	307	301	275	382	255	-172	-042	-035	-164								
Scientific	26.00	7.65	095	-056	-007	002	122	185	272	-100	096	221	193	002	-050	226	046	160	205	178	178	070							
Persuasive	45.38	9.85	195	313	376	166	143	216	135	302	024	145	-023	-082	-117	-070	-257	104	019	-462	-503	-273	-348						
Artistic	35.78	7.14	-173	-127	-161	-349	-127	-227	-024	-265	-157	-404	-228	-106	087	-104	-368	-348	-425	282	499	-150	-135	-303					
Literary	23.75	7.94	412	236	226	462	431	239	191	411	308	344	325	417	165	243	124	088	133	-089	-369	421	-310	195	-139				
Musical	25.03	4.70	-027	118	023	030	-034	-154	109	151	023	263	206	339	272	195	256	-023	046	-282	-164	182	-202	-008	-080	018			
Soc. Service	48.06	14.01	-059	-122	036	007	-183	006	-144	-207	-167	-329	-318	-473	-297	-550	-014	214	103	-155	-086	-500	-129	008	-098	-435	-306		
Clerical	32.19	11.02	-027	009	056	058	069	082	029	159	022	201	024	055	-171	200	276	007	120	-255	-293	422	104	134	-518	-002	117	-349	
CRITERION																													
Performing Arts	68.13	6.44	292	140	388	191	191	111	264	230	184	083	135	271	-024	025	015	209	203	-202	-090	-319	-069	057	-051	044	-009	176	-140

TABLE XVI

MEANS, STANDARD DEVIATIONS, AND INTERCORRELATIONS
FOR TWENTY-EIGHT VARIABLES OF THE AUTOMOTIVES "22" GROUP (N = 94)

PREDICTORS			GRADE IX RECORD									DIFFERENTIAL APTITUDE								KUDER-VOCATIONAL									
	MEAN	SD	Agg. St.	Read.	Lit.	Lang.	Soc. S.	Math.	Science	Verb.	Quant.	Verb. R.	Num. A.	Abst. R.	Space R.	Mech. R.	Cl. S&A	Spell.	Gram.	Outd.	Mech.	Comp.	Sci.	Pers.	Art.	Lit.	Mus.	S. Serv.	Cler.
Agg. Stanine	4.83	1.28																											
Reading Test	4.62	1.39	647																										
Literature	4.52	1.31	665	412																									
Language	4.37	1.42	675	366	570																								
Social Studies	4.82	1.30	725	459	541	408																							
Mathematics	4.69	1.45	703	382	283	306	402																						
Science	5.47	1.34	801	460	478	398	529	555																					
Verbal SCAT	5.06	1.37	546	536	507	456	433	209	281																				
Quant. SCAT	4.85	1.59	601	469	239	514	432	622	370	275																			
Verb. Reas.	29.72	7.50	473	550	311	447	373	207	299	519	312																		
Num. Abil.	28.18	6.54	646	367	339	459	527	622	526	271	590	438																	
Abst. Reas.	34.94	6.40	438	346	258	309	349	353	400	143	508	391	509																
Space Rela.	36.88	11.02	335	324	146	203	187	355	242	245	361	394	404	451															
Mech. Reas.	55.00	6.34	289	232	010	098	220	220	276	269	171	292	321	344	459														
Clerical S&A	55.12	10.56	-083	086	-203	-102	-005	056	-049	-169	153	045	131	025	344	235													
LU-I: Spell	72.17	11.58	490	399	384	539	463	154	367	440	307	413	416	203	104	238	142												
LU-II: Gram.	29.86	7.01	429	368	377	433	279	219	280	445	343	444	394	406	373	322	118	538											
Outdoor	52.79	14.07	-097	038	-129	-106	-095	-117	-090	-071	-051	-023	-186	-094	104	082	121	-065	052										
Mechanical	51.82	8.89	083	135	-028	041	025	081	160	035	145	023	186	-031	149	286	159	-070	118	173									
Computational	24.34	6.72	068	-058	-079	006	096	204	-011	-122	270	-010	236	342	175	-001	182	-016	055	-244	-109								
Scientific	41.73	9.10	037	-088	004	-011	-016	-073	097	-158	-021	027	-056	-182	-015	-091	014	-059	-042	170	177	080							
Persuasive	37.90	9.31	023	036	157	-015	054	051	-029	201	-013	-087	-067	-097	-134	-164	-056	-020	-012	-292	-236	-151	-327						
Artistic	28.27	7.68	-108	-167	-066	-106	-139	-036	-007	-276	-093	-158	-026	-017	094	-059	047	-058	-165	-045	-081	-192	-070	-163					
Literary	15.68	6.39	-028	-008	010	-109	141	-099	-036	142	-136	105	-135	-170	-127	-026	-142	160	-129	-089	-340	-102	-101	004	-167				
Musical	9.82	6.05	-036	-011	173	-073	008	-048	021	-052	-208	119	058	062	-256	-064	-179	059	-079	-178	-425	-111	-080	262	-105	054			
Soc. Service	33.23	10.92	-073	014	-117	-039	-109	-092	-111	031	-001	026	-017	047	-118	066	-133	-057	039	007	069	-052	-120	-272	-212	-037	-239		
Clerical	46.84	12.10	095	-102	007	236	072	197	004	-041	215	-123	078	200	-007	-132	052	058	044	-445	-191	391	-248	171	065	-217	-048	-307	
CRITERION																													
Automotives	57.18	11.74	244	233	121	-023	282	232	245	231	103	204	174	035	391	357	288	168	246	-036	130	080	-015	-010	128	131	-168	-074	-159

TABLE XVII.

MEANS, STANDARD DEVIATIONS, AND INTERCORRELATIONS
FOR TWENTY-EIGHT VARIABLES OF THE BEAUTY CULTURE "22" GROUP (N = 39)

PREDICTORS			GRADE IX RECORD									DIFFERENTIAL APTITUDE								KUDER-VOCATIONAL									
	MEAN	SD	Agg. St.	Read.	Lit.	Lang.	Soc. S.	Math.	Science	Verb.	Quant.	Verb. R.	Num. A.	Abst. R.	Space R.	Mech. R.	Cl. S & A	Spell.	Gram.	Outd.	Mech.	Comp.	Sci.	Pers.	Art.	Lit.	Mus.	S. Serv.	Cler.
Agg. Stanine	4.15	1.01																											
Reading Test	4.49	1.28	572																										
Literature	4.80	1.51	744	546																									
Language	4.85	1.01	638	345	340																								
Social Studies	3.87	1.13	685	374	665	212																							
Mathematics	3.92	1.37	731	370	414	448	455																						
Science	3.62	1.25	775	253	460	472	525	631																					
Verbal SCAT	3.97	1.41	576	639	631	293	646	274	324																				
Quant. SCAT	4.05	1.28	421	356	252	393	224	531	426	221																			
Verb. Reas.	27.03	7.45	616	656	514	495	458	386	310	664	418																		
Num. Abil.	23.92	5.96	477	268	359	272	179	640	452	107	592	333																	
Abst. Reas.	34.62	6.24	267	382	109	232	019	479	190	209	264	393	462																
Space Rela.	28.10	9.71	407	647	354	491	182	319	075	502	184	567	120	510															
Mech. Reas.	42.28	7.08	291	477	255	318	090	277	054	408	272	537	074	448	648														
Clerical S & A	62.44	12.95	127	235	072	123	110	304	168	-051	473	-005	214	051	-091	009													
LU-I: Spell.	79.95	11.77	270	333	133	518	-016	182	131	062	254	247	025	121	241	192	334												
LU-II: Gram.	31.77	7.10	498	362	349	510	170	503	468	268	257	473	198	482	414	326	012	515											
Outdoor	33.28	12.21	-176	-195	-248	-047	-164	-120	-224	-096	099	097	038	-019	-035	282	021	-059	-249										
Mechanical	23.80	6.51	093	117	138	111	183	110	-169	135	039	163	-042	235	226	319	201	105	007	229									
Computational	18.74	6.27	011	-287	-201	101	-150	136	266	-270	153	-209	142	002	-247	-088	197	104	143	-028	-251								
Scientific	30.10	10.14	239	-087	117	235	158	217	184	033	006	-031	-081	107	181	263	037	232	114	284	245	340							
Persuasive	42.08	9.19	052	060	094	120	074	-115	120	023	107	-200	141	-109	-097	-345	-032	-085	-211	-416	-086	-089	-365						
Artistic	31.18	9.02	213	397	301	-008	246	149	002	314	084	365	233	181	232	-002	-080	-085	100	-246	-053	-512	-542	344					
Literary	15.95	8.14	007	068	184	136	057	-192	-030	235	-149	194	-178	-241	070	077	-136	084	-035	-023	-228	-300	-110	-083	-052				
Musical	10.77	6.07	121	263	049	148	122	061	106	280	226	093	028	-115	066	-149	205	-033	-022	-271	-295	-156	-411	387	350	045			
Soc. Service	58.98	8.98	-092	-155	-168	098	-115	107	-203	-134	000	050	-009	181	041	342	-077	066	046	410	347	259	335	-365	-374	-073	-484		
Clerical	50.13	14.05	-101	-193	-225	-039	-180	132	109	-323	016	-294	017	145	-261	-237	078	223	284	-401	-226	523	200	042	-190	-358	-229	113	
CRITERION																													
Beauty Culture	68.21	12.85	284	039	130	130	292	435	497	005	230	108	266	275	117	065	089	-366	125	167	044	-114	-059	057	235	-221	038	-182	-018

TABLE XVIII

MEANS, STANDARD DEVIATIONS, AND INTERCORRELATIONS
FOR TWENTY-EIGHT VARIABLES OF THE COMMERCIAL ART "22" GROUP (N = 85)

PREDICTORS			GRADE IX RECORD									DIFFERENTIAL APTITUDE								KUDER-VOCATIONAL									
	MEAN	SD	Agg. St.	Read.	Lit.	Lang.	Soc. S.	Math.	Science	Verb.	Quant.	Verb. R.	Num. A.	Abst. R.	Space R.	Mech. R.	Cl. S&A	Spell.	Gram.	Outd.	Mech.	Comp.	Sci.	Pers.	Art.	Lit.	Mus.	S. Serv.	Cler.
Agg. Stanine	4.88	1.19																											
Reading Test	5.66	1.55	639																										
Literature	5.34	1.53	709	537																									
Language	5.01	1.52	688	428	578																								
Social Studies	4.86	1.30	767	443	502	327																							
Mathematics	4.32	1.28	759	301	447	549	512																						
Science	4.85	1.37	758	330	417	374	643	645																					
Verbal SCAT	5.66	1.52	597	657	530	435	516	318	392																				
Quant. SCAT	4.13	1.65	647	387	506	453	487	696	527	360																			
Verb. Reas.	33.22	7.56	666	666	471	400	533	481	557	576	533																		
Num. Abil.	26.55	6.43	635	295	336	444	477	719	528	215	707	533																	
Abst. Reas.	36.10	7.63	484	305	321	207	369	442	446	182	460	553	510																
Space Rela.	35.46	10.82	400	043	100	056	360	502	558	127	487	391	501	552															
Mech. Reas.	48.55	8.74	279	061	007	-029	330	370	455	192	280	341	385	305	518														
Clerical S&A	54.55	11.01	110	010	044	017	025	097	131	-160	190	053	126	052	209	-056													
LU-I: Spell	79.06	12.72	363	387	435	460	238	317	090	269	345	281	329	192	-138	-098	093												
LU-II: Gram	34.58	8.80	561	476	485	473	437	395	419	490	249	525	269	323	212	207	029	317											
Outdoor	39.26	11.75	224	270	231	218	138	111	244	240	142	309	060	126	165	267	013	042	366										
Mechanical	28.75	11.06	030	-169	-088	-204	110	197	262	-054	127	140	194	214	417	568	-076	-019	085	147									
Computational	16.35	7.45	-247	-466	-284	-216	-088	-118	-132	-385	-091	-297	010	-153	003	094	048	-232	-285	-369	048								
Scientific	28.27	8.98	-025	-105	-060	-067	137	026	089	029	126	079	044	-035	228	286	113	-212	077	213	166	144							
Persuasive	43.44	8.55	049	-003	-003	-016	181	065	051	130	-009	002	019	-073	-072	-027	-089	-009	-119	-303	-104	-107	-185						
Artistic	46.68	5.55	061	015	017	010	055	058	188	-005	-087	028	044	074	179	-039	170	-077	026	096	119	-106	-151	-078					
Literary	18.65	7.54	-028	100	164	015	066	-173	-043	142	-085	066	-072	-162	-130	-037	079	093	154	067	-216	-021	035	-017	-229				
Musical	12.38	5.98	157	040	099	028	138	100	071	006	-001	083	-033	085	112	007	077	058	-067	-080	-048	-091	-162	074	-159	101			
Soc. Service	43.92	15.97	-001	206	103	173	-167	-032	-231	150	099	026	068	096	-221	-325	-063	160	-009	-125	-375	-277	-268	-058	-175	-222	-251		
Clerical	41.12	13.69	-315	-328	-233	-243	-151	-247	-275	-201	-253	-395	-323	-214	-240	-253	-100	-020	-320	-384	-185	492	-021	-002	019	-046	-110	-343	
CRITERION																													
Commercial Art	61.94	11.42	278	-016	050	171	267	347	435	-054	278	253	355	321	429	279	177	-063	192	138	144	-009	199	-063	323	-116	-101	-073	-263

TABLE XIX

MEANS, STANDARD DEVIATIONS, AND INTERCORRELATIONS
FOR TWENTY-EIGHT VARIABLES OF THE COMMERCIAL FOOD "22" GROUP (N = 61)

PREDICTORS			GRADE IX RECORD									DIFFERENTIAL APTITUDE								KUDER-VOCATIONAL									
	MEAN	SD	Agg. St.	Read.	Lit.	Lang.	Soc. S.	Math.	Science	Verb.	Quant.	Verb. R.	Num. A.	Abst. R.	Space R.	Mech. R.	Cl. S&A	Spell.	Gram.	Outd.	Mech.	Comp.	Sci.	Pers.	Art.	Lit.	Mus.	S. Serv.	Cler.
Agg. Stanine	4.23	1.13																											
Reading Test	4.79	1.60	487																										
Literature	4.23	1.28	618	575																									
Language	3.90	1.59	671	286	657																								
Social Studies	4.28	1.31	735	308	399	311																							
Mathematics	4.36	1.32	738	258	295	543	348																						
Science	4.51	1.27	739	225	285	297	605	575																					
Verbal SCAT	4.92	1.57	554	713	521	343	409	344	329																				
Quant. SCAT	4.52	1.57	580	218	246	329	400	650	533	349																			
Verb. Reas.	27.64	8.26	551	512	414	305	444	404	452	546	496																		
Num. Abil.	26.67	6.90	341	093	018	172	266	483	251	166	602	409																	
Abst. Reas.	34.38	7.97	292	209	094	066	240	279	324	223	477	598	385																
Space Rela.	28.57	10.67	371	246	103	201	252	342	273	257	370	462	252	625															
Mech. Reas.	46.11	8.91	336	185	049	035	290	237	531	350	282	394	141	437	471														
Clerical S&A	51.44	11.28	059	024	010	250	121	150	-156	023	277	-011	334	011	496	-178													
LU-I: Spell	72.97	13.01	453	408	429	593	242	388	044	430	332	247	296	126	106	-022	388												
LU-II: Gram	28.89	7.87	533	398	384	530	336	380	304	477	405	481	382	490	518	196	013	388											
Outdoor	47.13	13.10	-038	-038	012	-081	116	-194	084	-061	002	181	161	135	-035	230	-064	-160	104										
Mechanical	35.23	11.70	-122	-120	-258	-436	028	-161	035	-004	028	-009	005	081	181	445	-004	-227	-220	314									
Computational	22.80	8.12	-035	-254	-208	-167	-015	121	118	-080	316	-015	073	172	052	140	128	-190	-103	-133	115								
Scientific	38.93	10.49	-027	-116	-135	-161	060	-138	277	014	101	143	087	136	-003	353	-136	-162	-095	394	358	155							
Persuasive	39.69	10.34	086	-018	028	-012	114	079	-033	133	094	-149	-114	-088	066	016	-054	125	-085	-415	-041	107	-255						
Artistic	28.07	10.75	-060	-125	-089	032	011	-095	-102	-151	-137	031	037	209	223	041	-019	030	106	-027	-134	-232	-179	-148					
Literary	18.84	7.64	174	254	271	196	-010	233	-014	332	037	195	-027	110	-071	-084	-032	196	187	-068	-230	-080	-262	-145	-066				
Musical	11.26	6.01	-097	-148	-084	-002	-063	-067	011	-213	005	-253	-155	033	-083	-044	-092	066	-003	016	-167	-037	-156	218	-063	-024			
Soc. Service	41.31	16.63	-012	174	066	220	-198	018	-149	011	-256	-072	-011	-317	-130	-411	060	117	032	-319	-393	-421	-234	-193	-046	-138	-166		
Clerical	45.52	12.43	003	-074	-034	062	-061	213	-093	-058	156	-197	070	-066	-044	-186	264	049	025	-400	-222	566	-268	175	-180	020	-143	-119	
CRITERION																													
Commercial Food	60.74	11.14	357	270	180	240	312	197	396	189	159	270	227	-004	066	068	037	180	200	153	-113	-056	-087	-113	-241	-114	-032	299	-023